{In Archive} West Lake Landfill: Region 7 DRAFT feedback on Batch 3 SFS RTCs

Dan Gravatt to: Rich Kapuscinski 05/10/2011 02:39 PM

Cc: Doug Ammon

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Rich,

As you requested in this afternoon's update call, here is my DRAFT feedback on all the Batch 3 RTCs:

Responses to RIM Characterization Comments EPA feedback.docx

Section 3 - RIM Characterization EPA feedback.doc

Responses EPA Addl 5, 6, 10, 17, 21, 28 & 29 and MDNR 15, 16, 17, 88 & 116 - Site Conditions EPA feedback.docx

Responses re Report Organization & Introduction EPA Addl 11, 12, 13, 26 & 38 EPA feedback.doc

Alternative Evaluation Criteria EPA feedback.doc

EPA 15 and 38 - Waste Acceptance and Offsite Rule EPA feedback.doc

Responses to EPA 17, EPA Addl 33 & 46 and MDNR 53 RE solids separation EPA feedback.doc

Response to EPA 23 RE Onsite Cell Cover Design EPA feedback.doc

On-Site Cell Capacity - EPA Sp 42 and MDNR 54 & 63 4-7-11 EPA feedback.doc

EPA Specific Comment 55 - Waste Settlement EPA feedback.doc

Long Term OMM Costs - MDNR 47 48 74 76 and 91 EPA feedback.doc

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EPA General Comment No. 2, EPA Additional Comments No. 1, 2, 14, 15, 16, 30, 37, 42, 44, and 47 and MDNR Section-Specific Comments 19 and 116 – RIM Characterization

Comments

EPA Specific Comment No. 2

2. Section 3.1 of the SFS workplan states that the SFS will include an evaluation of potential occurrences of principal threat wastes. This evaluation was not found in the SFS and must be included.

EPA Additional Comment No. 1

1. The final document should include a full and accurate characterization of the radioactive and other (e.g., RCRA hazardous waste) materials. Among other things, it should address EPA's principal threat determination guidance (OSWER Directive 9380.3-06FS). Based on information and data contained in the remedial investigation (RI) report, as well as two NRC reports (1982 and 1988 described more fully in #2 below), it would be appropriate to conclude that the radioactive materials could pose "a significant risk to human health should exposure occur" because these materials have "high concentrations of toxic compounds." For example, in light of the fact that cleanup level is 5 pCi/g, it is significant that the NRC reports state that subsurface soil contamination concentrations of Ra-226 (radium) are up to 22,000 pCi per gram (1988 report at p. 9). The remedial investigation report indicates radionuclide concentrations as high as those reported by NRC.

   Consistent with the statute, NCP and program guidance, principal threat waste (PTW), whether radioactive or chemical, triggers the need to evaluate treatment options (which could be added to current Section 4). Thus, the SFS needs to explain how the remedial alternatives for OU1 at this Site satisfy the preference for treatment to significantly reduce toxicity, mobility, and volume. The materials may be considered PTW in accordance with the NCP, therefore, a discussion of the treatment of PTW needs to be included. The draft report does not indicate whether any treatment, including stabilization technologies, was considered.

EPA Additional Comment No. 2

2. The final document's full and accurate characterization of the radioactive materials should explicitly reconcile the data and findings of the RI with the data, primary findings, and conclusions of a radiological survey conducted by Radiation Management Corporation (RMC) for NRC in 1980-1981 (and published in 1982), and the 1988 NRC Summary Report, including:

- Radioactive contaminants are in two areas (which were subsequently designated as Radiological Disposal Areas 1 and 2) (at page 20 of RMC report). Almost all of the radioactivity is from uranium (U-238 and U-235) and its decay products (at page 20). Radioactivity is dominated by thorium-230 and radium-226.

- In addition, " . . . the radioactive decay of the Th-230 will increase the concentration of its decay product Ra-226 until these two radionuclides are again in equilibrium. . . .the Ra-226 activity will increase by a factor of five over the next 100 years, by a factor of nine 200 years from now, and by a factor of thirty-five 1000 years from now. . . Therefore, the long-term Ra-226 concentration will exceed the Option 4 criteria. Under these conditions, onsite disposal, if possible, will likely require moving the material to a carefully designed and constructed 'disposal cell.'" (1988 report at p. 13). And in the Summary section, the 1988 report (at p. 15) states: "A dominant factor for the future is that the average activity concentration of Th-230 is much larger than that of its decay product Ra-226, indicating a *significant increase in the radiological hazards in the years and centuries to come.*" (emphasis added).

- Subsurface deposits extend beyond areas where surface radiation measurements exceed [NRC] action criteria.

- "In general, the subsurface contamination appears to be a continuous single layer, ranging from two to fifteen feet thick, located between the elevations of 455 feet and 480 feet and covering 16 acres total area." (at page 15 and similar language at page 21); "a fairly continuous, thin layer of contamination, as indicated by survey results" (1982 report at p. 16); "The contaminated soil forms a more or less continuous layer from 2 to 15 feet in thickness (1988 report p. 5); "the waste was covered with only about 3 feet of soil." (1988 report at p. 1).

- These data are generally "... consistent with the operating history of the site, which suggests that the contaminated materials was moved onto the Site within a few days time, and spread as cover over fill material." (at page 16 and similar language at page 20)

EPA Additional Comment No. 14

14. It is logically awkward to partially discuss cleanup levels (Section 2.2) in advance of a discussion of ARARs (Section 3.1, which includes additional discussion about cleanup levels), and within a section that otherwise is devoted to site-specific information about land use, operations, and hydrology. A more satisfactory alternative organization would entail a separate discussion of RIM presence, distribution and extent (say new Section 4) that follows the discussion of ARARs (Section 3.1) and precedes the 'Technology Screening' (currently Section 4). If a new Section 4 is created for these purposes, then Section 2 could still retain a general discussion of the nature of the RIM (e.g., origins, amounts disposed over what time period, primary radiological parents, expected

longevity and in-growth of the radioactivity), but would not introduce the volume estimates nor discuss the distribution of RIM within the landfill.

EPA Additional Comment No. 15

15. We recommend a separate section devoted to the characterization of radiologically impacted materials (RIM) to consolidate the relevant discussions and conclusions that are dispersed in the current draft (e.g., the discussion of uncertainty in the volume estimates is in Section 5.3.1 in the current draft) and provide a full, accurate and up-to-date characterization of the RIM, one that (among other things) is consistent with the statute, NCP and EPA guidance (e.g., principal threat waste guidance), and consistent with comments provided on the March 22 draft work plan (see comment 2 above). It also will provide for a transparent discussion about whether the RI data are consistent with or different than the NRC data and/or can be reconciled with various statements and conclusions in those reports (for example, that radioactive soil was disposed during a limited portion at the end of the operating history of the two radiological areas), including all those described in comments 1, 2 and 9 above.

EPA Additional Comment No. 16

16. To help make this document more self-sufficient, the scope of the remedial investigations of RIM presence should be summarized and consolidated in the final document (e.g., should incorporate information about boring density that is provided in Section 5.3.1 (page 58) of the current draft). Such a summary would provide an opportunity to explain the extent to which the NRC data were considered and evaluated in designing the RI. In light of not finding discrete layers of radioactive soil during the boring investigation and attributing radioactivity at unexpected depth in certain locations to artifacts of the boring investigation, the summary should also address and discuss whether the methods used during the RI to evaluate RIM presence were appropriate and sufficient for purposes of definitively determining the distribution of radioactivity within the landfill. This content could be incorporated into a new Section 4, dedicated to a discussion of RIM occurrences and spatial extent, as recommended above.

EPA Additional Comment No. 30

EPA Additional Comment No. 37

37. The final SFS needs to contain specific factual statements that are supported by data, rather than general characterizations. So, for example, the final report needs to report the activity concentrations of uranium and thorium in barium-sulfate residues (see page 7, Section 2.2.1), rather than to claim without further documentation that barium-sulfate residues contained only "traces" of uranium and thorium. Likewise, statements that the radioactivity levels in the waste materials are "low" (See page 94), if true, needs to be backed up with specific, credible sampling data compared to specific benchmarks of

safety. Similarly, given the specific language in the NRC reports to the contrary, the final report needs to provide a readily recognizable, verifiable, scientific basis for the characterizations (see page 8) that "radionuclides are present in a dispersed manner *throughout* the landfill deposits" and "the soil containing radionuclides is intermixed and *interspersed within the overall matrix* of landfill refuse, demolition and construction debris, fill materials, and unimpacted soil" or for the claim (see page 92) that "Long-term site management plans and institutional controls would be *robust and durable*." [emphasis added]. Among other considerations, the statement that "radionuclides are present in a dispersed manner throughout the landfill deposits" appears to be inconsistent with certain conclusions reached in the NRC reports (e.g., see quotes above in comment 2) and the RI report, which suggest a more limited, but well-defined vertical distribution (e.g., "In the northwestern part of Area 1, radiologically impacted materials were identified at depths generally ranging between 0 and approximately 6 feet" (at page 92 of the April 2000 RI report); Radiologically impacted materials were generally found at depths ranging between 0 to approximately six feet in the northern and southern parts of Area 2 (at page 97 of the RI report)).

EPA Additional Comment No. 42

42. Page 28, third paragraph: See comment 22 above. The basis of calling radioactive contamination "low activity" is not apparent, particularly since most of the owners and operators of licensed disposal facilities consider it too radioactive to accept. The radium-226 concentrations at UMTRCA sites generally are not above 1,000 pCi/g, but West Lake has multiple hits over 10,000 pCi/g. For these and other reasons set forth herein, the term "low activity" should not be used to characterize the radioactive waste in the landfill.

EPA Additional Comment No. 44

44. Page 105, second and third paragraphs: See comment 22 above. The waste should not be characterized as "low activity." Among other considerations, characterizing the waste as "low activity" is undermined where the draft report states that a remediation worker will get 499 mrem/yr exposure for off-site disposal option, and that OSHA equipment and practices may not provide adequate protection for workers. For these and other reasons set forth herein, the term "low activity" should not be used to characterize the radioactive waste in the landfill.

EPA Additional Comment No. 47

47. Table 5, PVC-21, depth 18 feet: The result of 4.4 billion pCi/g for this sample appears to be in error and must be corrected.

MDNR Section-Specific Comment No. 19

19.) Section 2.2.1 General Nature of the RIM, page 8- The document states "Data collected during the RI are consistent with this account." when discussing the radiologically contaminated soil was used as cover over municipal refuse. Please include and discuss the data from the RI that supports these statements.

MDNR Section-Specific Comment No. 19

116.) Figure 4: Extent of Radiologically Impacted Material - Please show the radioactive contamination on the Buffer Zone/Crossroad property.

Discussion

A new Section 3 – RIM Characterization is attached and will be included in the revised SFS.

All qualitative references to the actvitity levels such "low activity levels" will be removed from the report.

Presentation of the volume of RIM that would need to be excavated is a function of the cleanup levels. As indicated in the comments, it is "It is logically awkward to partially discuss cleanup levels (Section 2.2) in advance of a discussion of ARARs…" Consequently, the discussion of the volume of RIM that would need to be removed under one of the "Complete Rad Removal" alternatives will be presented as part of the description of the "Complete Rad Removal" alternatives. As a result, the discussion of the volume of RIM will be presented subsequent to the discussion of ARARs which will now include a discussion of the cleanup levels.

SFS Text Revisions

Please see the attached Section 3 – RIM Characterization.

EPA FEEDBACK:

EPA accepts this discussion. However, Section 3 includes the PRP's original proposed RTCs (or something very similar) regarding Principal Threat Waste and the RI vs. NRC comparison, rather than the EPA feedback versions for these issues which were much shorter. Also, Table 1 and "Table 2" are identical, having only different filenames.

3 RADIOLOGICALLY-IMPACTED MATERIALS

This section summarizes the origin and general nature and distribution of the radiologically-impacted materials (RIM) occurrences in Areas 1 and 2. The characterization of the RIM occurrences is based on the results of the prior Nuclear Regulatory Commission (NRC) investigations of the site (NRC, 1982 and 1988 and RMC, 1981), the results of the sampling performed during the RI (McLaren/Hart 1996, EMSI, 1997 and 2000).

3.1 Source of the RIM

Reportedly, 8,700 tons of leached barium-sulfate residues were mixed with approximately 39,000 tons of soil and then transported to the West Lake Landfill in 1973 (EPA, 2008, NRC, 1988). The barium-sulfate residues were reportedly derived from Uranium ore processing and were initially stored by the Atomic Energy Commission (AEC) on a 21.7-acre tract of land in a then-undeveloped area of north St. Louis County, now known as the St. Louis Airport Site (SLAPS) (EPA, 2008, NRC, 1988 and 1982). SLAPS is part of the St. Louis Formerly Utilized Sites Remedial Action Program (FUSRAP) sites which are managed by the U.S. Army Corps of Engineers (USACE). Certain Radium and lead-bearing residues, known as K-65 residues, were stored in drums at SLAPS prior to relocation to federal facilities in New York and Ohio (EPA, 2008, NRC, 1988). In 1966 and 1967, the remaining residues from SLAPS were purchased by a private company for mineral recovery and placed in storage at a nearby facility on Latty Avenue under an AEC license (EPA, 2008, NRC, 1988). Most of the residues were shipped to Canon City, Colorado, for reprocessing (EPA, 2008, NRC, 1988). Leached barium-sulfate residues were not shipped off-site as these were the least valuable in terms of mineral content because most of the Uranium and Radium had been removed in previous precipitation steps (EPA, 2008, NRC, 1988).

3.2 General Locations of RIM Occurrences

Radionuclides have been identified as being present in two distinct and separate areas at the landfill. These two areas have been designated as Radiological Area 1 (Area 1) and Radiological Area 2 (Area 2) (Figure 12 *NOTE: This figure was provide as part of the revised Section 2*). All of the prior investigations of radionuclide occurrences at West Lake Landfill (RMC/NRC, 1982, NRC, 1988, EMSI, 2000, EMSI, 2006, and EMSI, 2010) have identified these same two areas as the locations where radionuclides are present at the Site. Area 1 encompasses an approximately 10 acre portion of the site located immediately to the southeast of the main entrance road to the West Lake Landfill property. Area 2 encompasses approximately 30 acre portion of the site along the northern boundary of the West Lake Landfill property (Figure 12).

NRC (1988) described the extent of radiological occurrences in Area 1 and 2 as being 3 acres and 13 acres in size respectively. The RI report (EMSI, 2000), identified somewhat larger extents of radiological occurrences including 4.5 acres in Area 1 and 19.2 acres in Area 2. The results of both the NRC investigations and the RI indicated that the subsurface extent of radionuclide occurrences in Areas 1 and 2 is greater than the surface extent of radionuclide occurrences in these areas.

The RI also identified approximately 4.5 acres of the adjacent (northern) property (formerly the Ford property but subsequently known as the Buffer Zone and a portion of the Crossroad property) as potentially containing radiological occurrences in surficial soil. It should be noted that subsequent to the RI, this area was scraped and graded by the occupant of the adjacent property, with much of the surficial soil being pushed back toward the landfill. In addition, gravel cover was placed over the Crossroad portion of this area. Consequently, the current extent of radiological occurrences in this area is uncertain and therefore will be subject to additional characterization during the Remedial Design effort.

During preparation of SFS, the extent of radiological occurrences in Areas 1 and 2 was rigorously examined to provide a basis for estimating the volume of material that would need to be excavated pursuant to the "complete rad removal" alternatives. The data collected during both the NRC and the RI investigations were used in this evaluation. The specific procedures and data used to identify the extent of radiologically-impacted materials are fully described and presented in Appendix A to the SFS. Based on the SFS evaluations, the extent of radiological occurrences in Areas 1 and 2 were defined to be 4.4 acres and 21.7 acres, respectively. The areal extent of the RIM occurrence identified during the SFS for Area 1 (4.4 acres) is similar to the areal extent (4.5 acres) previously identified during the RI, but greater than the 3 acre extent identified by NRC (1988 and 1982). The areal extent of the RIM occurrence identified during the SFS for Area 2 (21.7 acres) is 13% greater than the areal extent (19.2 acres) previously identified during the RI, and substantially larger than the 13 acre extent identified by NRC (1988 and 1982). The greater extent of RIM estimated during the SFS results from use of more rigorous procedures to define the extent of RIM during the SFS, and development of separate estimates of the lateral extent of upper and lower subsurface occurrences of RIM in Area 2.

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Figure 1 *Note: This figure will need to be re-numbered based on the preceding figure numbers* presents and compares the extent of RIM identified in the 1982 NRC report, the 1988 NRC report, the 2000 RI report, and the 2010 SFS report. Although close examination indicates that differences exist in the definition of the lateral extent of RIM occurrences as described in these four reports, all four reports are generally consistent in that they identified similar general areas of RIM occurrences at the site.

3.3 General Distribution of RIM Occurrences

Radionuclides are present in a dispersed manner throughout the landfill deposits in Area 1 and Area 2. Radiological constituents primarily occur in soil that was reportedly used as daily or intermediate cover. According to the landfill operator, the soil was used as cover for municipal refuse in routine landfill operations (TetraTech, 2009). Data collected during the RI are consistent with this account (TetraTech, 2009). Based on the presence of RIM with thickness greater than a few feet in certain locations, direct disposal of soil mixed with barium-sulfate residue may also have occurred at Areas 1 and 2; however, the RI soil boring logs did not identify the presence of any intervals consisting exclusively or predominantly of soil. Therefore, any soil containing barium-sulfate residue that may have initially been directly disposed at the landfill appears to have become mixed with waste materials as a result of concurrent or subsequent landfilling activities or differential settlement of the landfill materials over time.

The conceptual models of the nature and distribution of the RIM developed by the NRC investigations and the RI differ significantly. The 1988 NRC report states "In general, the contamination appears to be a continuous single layer ranging from 2 to 15 feet thick and covering 16 acres." It should be noted that this characterization appears to be in conflict with the graphical characterization portrayed on Figure 14 of the NRC report. Review of this figure, including adjusting to account for the fact that the figure does not represent a true cross-section (i.e., the figure does not present the borings in order or directional sequence and does not post results for adjacent borings next to each other), indicates that there are large variations in both the activity levels and the elevations at which radionuclides were identified by the NRC in Areas 1 and 2.

In contrast, the RI states "...the radiologically impacted materials present in Areas 1 and 2 are distributed throughout an overall matrix of solid waste materials including sanitary (household) wastes and construction and demolition debris." The RI goes on to state "Based upon observations of the cutting materials brought to the ground surface during the boring program, extensive discrete layers of soil, whether impacted or otherwise, were not identified." The RI also states "... a large portion of the radiologically impacted materials are present in the subsurface and occur in an interlayered and interspersed manner among the solid waste materials." The RI states further that "...occurrences of elevated downhole gamma readings as well as occurrence of radionuclides above reference levels or, even above background, were associated with a wide variety of solid waste materials containing varying amounts of soil."

The reasons for the reported differences in the conceptual understanding of the nature and distribution of the RIM developed by the two studies results from one or more of the following factors: (1) the nature and amount of the information collected and developed to describe the waste materials and contaminated soil, (2) consideration of landfill construction, operation and waste degradation processes, (3) the amount of time that elapsed between the two studies, and (4) variations in the intended degree of specificity or generality in the statements made regarding the conceptual distribution of the waste materials within the landfill. Each of these factors is discussed in the subsections below.

3.3.1 Type of Information Obtained

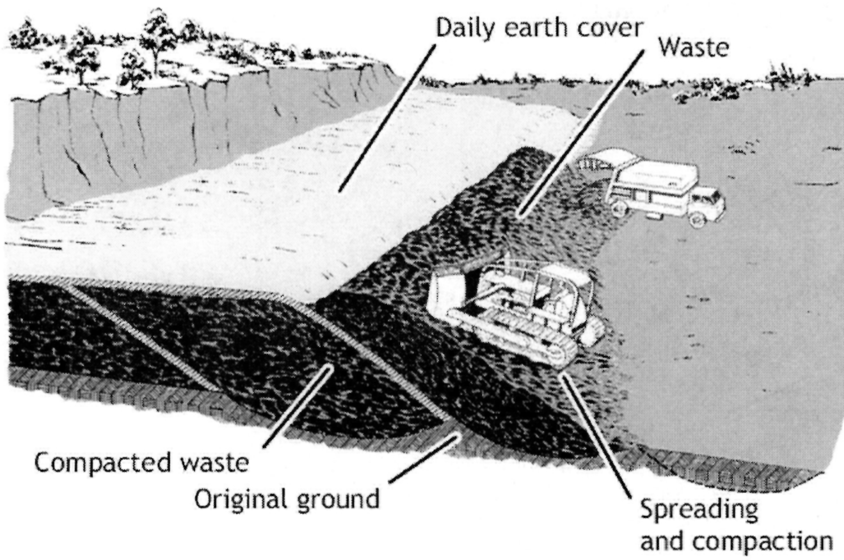
Both the NRC and the RI investigations drilled soil borings, performed downhole gamma logging of the soil borings and collected soil samples for laboratory analyses. No soil boring logs were included or described in the NRC reports and there is no indication that the materials encountered during drilling of the soil borings were logged or recorded during the NRC study. In contrast, the cuttings generated during drilling of the RI soil borings were logged and described by a field geologist (soil boring logs are included in the RI reports) based on inspection of large diameter bucket auger cuttings. The field geologists' observations indicate that the soil material within the landfill does not occur in a discrete layer or layers but instead is interspersed within the overall matrix of landfill wastes.

3.3.2 Consideration of Solid Waste Landfill Practices

Solid waste disposal methods do not result in a continuous and homogenous waste mass, but rather a series of smaller pockets or cells of waste next to each other, due to the progressive filling with waste over time. Each landfill cell is open and operated for a period of time (days, weeks, months or in some instances years) depending upon the size of the cell and the amount and rate of materials disposal at a site. Standard operating practice (EPA 1972), and since the 1970s and 1980s federal and state regulations, require placement of a thin layer of soil (currently 6-inches but minimum amounts were not specified prior to the 1970's and 1980s) over the waste materials at the end of each day of operations. Standard practice (EPA 1972) and later regulations required that areas in which landfill operations had been completed or that were not used for waste disposal for a period of six months or more be covered with an intermediate soil cover, generally consisting of approximately 12 inches of soil. Conceptual drawings illustrating landfill construction and operation activities that EPA presented during the public meetings for the site are presented below.

Construction of a solid waste landfill involves several processes that are specifically intended to redistribute or that indirectly redistribute the waste materials, including any soil material used for daily or intermediate cover during landfill operations. These processes include the following: initial dumping of the waste in or near a waste disposal cell; spreading of the wastes within the disposal cell; compaction of the wastes within a disposal cell; placement of daily soil cover layer over the disposal cell; dumping, spreading and compaction of wastes in the overlying disposal cells; placement of daily cover on top of the overlying disposal cells; placement and compaction of intermediate soil cover layer over completed disposal cells; and placement and compaction of final soil cover and construction of the vegetation layer. As can be seen in the figure below, daily soil cover layers are not necessarily placed in uniform, horizontal layers. In most landfills, intermediate soil cover layers also tend to be non-horizontal as compaction of landfill waste are configured for drainage or part of an exterior landfill sideslope. Proper landfill operation calls for daily and intermediate soil cover to be applied to both the top and sideslopes as construction of a landfill cell progresses, with the intent of leaving only the working face exposed. Proper landfill operation calls for covering of the working face at the end of each day of operations. Construction of landfill cells in this manner results in non-uniform, non-horizontal layers where soil used as daily or intermediate cover is present within the landfill mass.

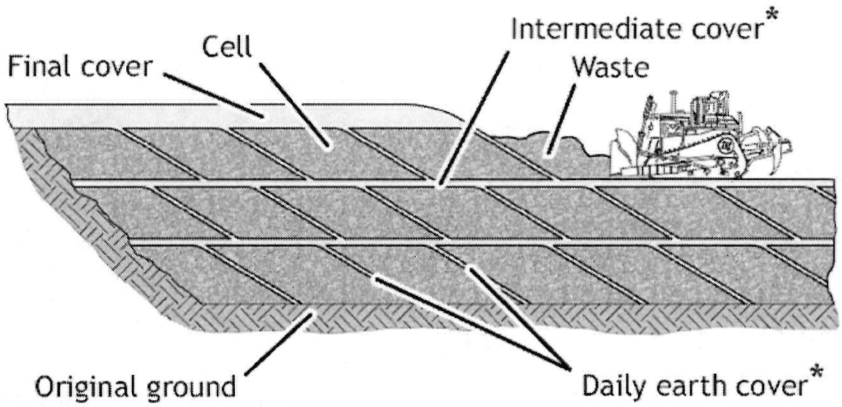
GENERALIZED LANDFILL OPERATION



Solid waste materials have different strengths and therefore do not compact equally. Large or more solid items such as construction and demolition debris, appliances, and other objects are strong and dense and subject to minimal compaction whereas household trash, yard trimmings, and other more putrescible wastes are weaker, less dense and more compressible through compaction. Consequently, solid waste materials are subject to differential compaction through the operating life of a landfill. Differential compaction and other processes result in differential displacement of the waste materials and soil cover layers immediately upon and long after placement of these materials in the landfill cell. Thus, although a daily or intermediate soil layer may be placed over a landfill cell at one time, from the time it is initially placed and subsequently through the years that follow, such soil layers do not occur or remain as a discrete, identifiable, homogeneous, isolated layers within a landfill but become mixed within the overall matrix of solid wastes disposed in the landfill.

Solid waste materials are also subject to microbial degradation, specifically anaerobic microbial degradation. It is the microbial degradation of the solid waste materials that results in generation of significant amounts of methane gas within solid waste landfills. It is well established that methane gas generation peaks within a few years after completion of landfilling and covering of a landfill and declines with time. Methane gas generation is a result of the overall microbial degradation, which consequently is also more extensive during the initial years after closure of a landfill. Microbial degradation results in decomposition of the waste materials which in turn causes compaction and settlement of the waste materials. Due to variations in the waste composition, landfill construction, variations in the waste moisture content and contact with

GENERALIZED LANDFILL CELL CONFIGURATION

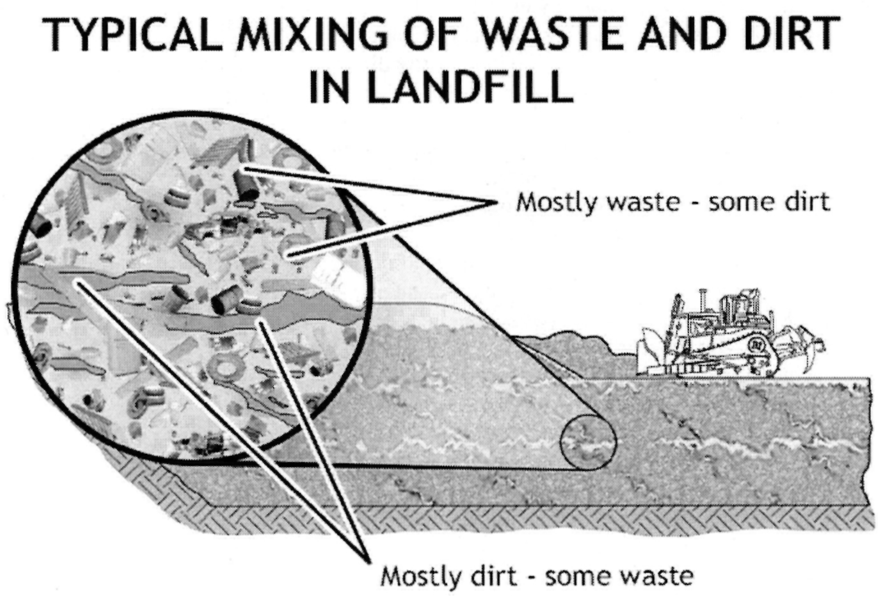


* Idealized soil layers. This configuration does not reflect mixing of soil with trash or distortion of soil layers by subsequent compaction and placement of additional fill.

precipitation, and other factors, decomposition, compaction and settlement of landfill waste materials does not occur in a uniform manner but rather landfill wastes are subject to differential compaction and settlement. Differential compaction and settlement is a condition that occurs over time and results in changes to the vertical distribution of the waste materials, and in particular the thin layers of daily and intermediate soil cover placed over the waste materials when active landfilling operations were being performed.

As a result of the processes initially conducted during construction of a landfill (i.e., waste dumping, spreading, compaction, placement of daily soil cover, construction of overlying waste cells, placement of intermediate soil cover, and construction of a final landfill cover as described above), plus the effects of microbial degradation and resultant additional differential compaction and settlement, the initially placed irregular soil cover layers become further disrupted and dislocated within the overall landfill mass.

Sanitary landfill wastes also settle as a result of filtering of fines (e.g., soil or other fine material moving downward through the landfill mass in response to gravity or water flow). The weight of the landfilled wastes also causes compaction and differential settlement of the waste materials. Application of superimposed loads resulting from stockpiling of soil or other materials over completed cells, or interim portions of a landfill, can cause significant compaction and differential settlement. This is a significant factor for a site such as the West Lake Landfill which also was used for stockpiling sand and gravel and other materials. Placement of stockpiles over previously deposited wastes results in significant additional compaction beyond that achieved with landfill equipment alone. As the placement of stockpiled materials is not uniform over a landfill surface and changes with time and continued operations, the resultant differential compaction and settlement that occurs is highly variable.



3.3.3 Time Between Studies

Nearly fifteen years elapsed between the time the NRC field work was performed (1981) and the time the RI field investigations were conducted (1995). Not surprisingly for a landfill site containing waste materials that are subject to microbial degradation, progressive decomposition and differential compaction, and settlement occurred as described above. The NRC investigation was performed only a few years after Areas 1 and 2 had been closed and at a time when ongoing landfilling and sand and gravel extraction and stockpiling were still occurring within the 200 acre site boundaries. For example, the 1980 RMC report (RMC was the contractor that performed the work for the NRC study) states "The [site] visit had been delayed over one month due to ongoing landfill operations in the area of interest to RMC." This report further states "This estimate [of the areal extent of contamination] assumes that contamination extends under the existing stone and gravel piles, where readings could not be made."

3.3.4 Degree of Specificity

There is also a question as to the degree of reliability or emphasis that should be placed on the NRC description of the nature and distribution of the RIM within Areas 1 and 2. The 1982 NRC report states "...the original volume of 40,000 tons has been diluted by a factor of about 4, which is not unexpected, with the continual movement and spreading of materials during filling operations." The NRC description of the distribution of the contaminated soil states "In general, the contamination appears to be a continuous single layer ranging from 2 to 15 feet thick and covering 16 acres." This statement begins with the qualifier "In general ..." without providing any description of the range of variability of the distribution of the waste materials or the degree of reliability subsequent readers should place on this sentence. The sentence could simply be intended to indicate that the contaminated soil is not randomly distributed within the landfill and not intended to provide a definite statement that the contaminated soil only occurs as an identifiable, homogeneous, discrete layer. Likely this sentence was intended to indicate that the occurrences of elevated gamma readings reflective of the presence of contaminated soil were identified within specific depth intervals and not to imply that the contaminated soil itself occurs in an isolated, discrete, homogeneous layer in Areas 1 and 2. This is supported by the statement presented in the 1988 NRC report "The manner of placing the 43,000 tons of contaminated soil in the landfill caused it to be mixed with additional soil and other material, so that now an appreciably larger amount is involved." The uncertain nature of the NRC's description of the occurrences of contaminated soil within Areas 1 and 2 is further reflected by the uncertainty expressed by the NRC regarding the volume of contaminated soil when the 1988 NRC report goes on to state "If it [the contaminated soil] must be moved, it is not certain whether the amount requiring disposal elsewhere is as little as 60,000 tons or even more than 150,000 tons."

3.3.5 Summary of General Distribution of RIM

Based on the results of both the NRC and RI investigations and consideration of the nature of landfill operations and landfill wastes, it is logical to assume that the soil containing radionuclides is intermixed with and interspersed within the overall matrix of landfilled refuse, demolition and construction debris, fill materials, and unimpacted soil. In some portions of Areas 1 and 2, radiologically impacted materials are present at the surface; however, the majority of the radiological occurrences are present at depth in these two areas.

3.4 Depth of RIM Occurrences

RIM is present both at the ground surface and in the subsurface in Areas 1 and 2. Both the NRC investigations (NRC, 1982 and 1988) and the RI investigations concluded that the subsurface extent of the RIM occurrences is greater than the surface extent. These two studies reached differing conclusions regarding the depths and vertical distribution of the RIM within Areas 1 and 2.

The 1988 NRC report concluded "Contaminated soil (>5 pCi Ra-226 per gram) is found from the surface to depths as great as 20 feet below the surface." The 1988 NRC report further states "In general, the contamination appears to be a continuous single layer ranging from 2 to 15 feet thick and covering 16 acres."

In contrast, the RI report states at page __ or Section __:

Comment [R71]: Need these references here and below.

> Review of the boring log information does not indicate the presence of any distinct or definable soil layers, whether radiologically impacted or otherwise, within the landfill matrix. Based upon the information presented in this section, it is EMSI's opinion that the sources of the radiological occurrences are dispersed within the volume of landfill materials described above for Areas 1 and 2.

With respect to the depth of RIM in Area 1 the RI states at page __ or Section __:

> Radiologically impacted materials were found to be present in the subsurface of Area 1 at two different depths. In the northwestern part of Area 1, radiologically impacted materials were identified at depths generally ranging between 0 and approximately 6 feet. In the southeastern portion of Area 1, radiologically impacted materials occur at a somewhat deeper interval ranging from 0 to approximately 15 feet.
>
> One location in Area 1 contains three borings (WL-105, well S-5, and well I-4) in close proximity that were all downhole logged for gamma radiation. Although the existing ground surface elevation of these three borings was quite close (467.2, 465.7, and 466 feet above mean sea level respectively) the depths to the gamma peak in each of these borings varied significantly. Depths of the gamma peaks and corresponding elevations ranged from 9-ft (elevation 458.2-ft) in WL-105 to 3.5-ft (elevation 462.2-ft) in well S-5 to 6.5-ft (elevation 459.5-ft) in well I-4. These data suggest that the depth and elevation at which the radiologically impacted materials occur varies highly over even small distances indicating that the horizon(s) in which the radiologically impacted materials occur are highly variable and highly irregular.

With respect to Area 2, the RI states at page __ or Section __:

> Based upon the results of the downhole gamma logging and the laboratory analyses, radiologically impacted materials were generally found at depths ranging between 0 to approximately 6 feet in the northern portion of Area 2. These depths correspond to elevations of approximately 457 to 462 feet above mean seal level. Deeper occurrences of radiologically impacted materials were identified in a few borings in the northern portion of Area 2. The sample obtained from the 20-foot depth in boring WL-226 contained 173-pCi/g Thorium-230 along with other radionuclides above background levels. This boring also displayed a downhole gamma peak at the 11-foot depth. Borings PVC-5, PVC-6, and PVC-7 displayed two separate gamma peaks with the lower peaks occurring at depths of 11 to 19.5 feet. Elevated downhole gamma readings were detected at a depth of 8-feet in boring PVC-19. A second interval of elevated downhole

gamma readings was measured at a depth of 7-feet in boring PVC-40. The sample from the 25-foot depth in WL-209 displayed a Thorium-230 concentration (26.9 pCi/g) greater than the subsurface reference level (17.45 pCi/g); however, analysis of the field duplicate sample from this same location and depth did not contain Thorium-230 above the subsurface reference level (12.85 pCi/g).

In the southern part of Area 2, radiologically impacted materials were identified at depths generally ranging between 0 and 6 feet. Deeper occurrences of radiologically impacted materials, specifically Thorium-230 levels above the reference level, were also identified in boring WL-233 in the southernmost portion of Area 2 where Thorium-230 was detected at the 27-foot depth at 427 pCi/g. Elevated downhole gamma readings were identified at a depth of 22 feet in this boring. Several radionuclides of the Uranium-238 decay series were detected at concentrations greater than their reference levels in the sample from the 10-foot depth from boring WL-234. A second interval of elevated gamma readings was identified at the 10-foot depth in boring PVC-10.

Both the NRC and the RI investigations drilled soil borings, performed downhole gamma logging of the soil borings and collected soil samples for laboratory analyses to define the lateral and vertical extent of radionuclide occurrences in Areas 1 and 2. As discussed above, no soil boring logs were included or described in the NRC reports while generalized boring logs based on inspection of large diameter bucket auger cuttings were included in the RI. Downhole gamma logs are included in the RI but are not included in the NRC reports; however, the NRC reports do contain tabular summaries of the downhole gamma counts for each 1-ft depth interval logged. One or two soil samples were collected from each of the RI soil borings and submitted to an offsite laboratory for radiochemical analyses. The NRC studies utilized an in situ gamma measurement system consisting of an intrinsic germanium (IG) detector coupled to a multichannel analyzer to perform qualitative and quantitative field analyzes during logging of the boreholes. Only eight surface soil samples (the locations of which are unspecified for most of the samples) and two borehole samples (sample depths unspecified) were collected and submitted for offsite radiochemical analyses as part of the NRC studies.

In addition to the differences in the general characterization of the depth of RIM between the RI and the NRC reports, the reported depths of the subsurface RIM occurrences differed between the two reports. As stated above, the 1988 NRC report states that "Contaminated soil (>5 pCi Ra-226 per gram) is found from the surface to depths as great as 20 feet below the surface." Although generally correct, the NRC characterization of the depth of contamination is not strictly correct in all cases. NRC logging of boring no. 22 indicated elevated gamma readings (>50,000 cpm) and corresponding elevated Radium-226 values (calculated values of 640 to 5,800 pCi./g) at depths of 23 to 25 ft bgs in this boring. The 25 ft depth was the maximum depth drilled so the actual vertical extent of contamination at this location cannot be determined from the available information. This boring was located in the southern portion of Area 2; however, this boring was not located during the RI field work. RI soil borings WL-233 and WL-235 were drilled near the presumed area of NRC boring no. 22. Logging of WL-233 and WL-235 identified the presence of elevated gamma readings with peak levels occurring at 22 and 22.5 ft bgs respectively. The NRC borings were drilled and logged to depths ranging from 21 to 39 ft bgs in Area 1, and 9 to

36 ft bgs in Area 2. The average depth of the ten NRC borings drilled and logged in Area 1 was 26.3 ft bgs while the average depth of the 30 NRC borings drilled and logged in Area 2 was 22.3 ft bgs. Nearly one fourth of the NRC borings (nine of the 39 borings drilled in areas 1 and 2) were drilled to depths of less than 20 ft bgs. All of these shallower borings were located in Area 2 where the RI identified the presence of deeper occurrences of RIM.

In contrast, the RI borings were drilled to depths of 15 to 105 ft bgs in Area 1, and 11 to 146 ft bgs in Area 2. Gamma logging of the RI borings was performed to depths ranging from 11 to 102 ft bgs in the Area 1 soil borings, and 7 to 54.5 ft bgs in the Area 2 soil borings. The average depth of the twenty RI borings drilled and logged in Area 1 was 38 ft bgs while the average depth of the 34 RI borings drilled in Area 2 was 31 ft bgs. Based on both downhole gamma logging and/or analytical laboratory results, the RI identified a number of locations where contaminated materials were present at depths below 20 ft bgs, and indeed extending to depths of as much as nearly 50 ft bgs at some locations.

Review of the NRC and RI studies identified fifteen locations where NRC and RI soil borings were drilled in the same general areas. Table 1 presents a summary comparison of the results of downhole logging and soil sample activity levels developed by the NRC and RI investigations for soil borings located in approximately the same general locations. For example, RI boring WL-112 was drilled in Area 1 approximately 80-ft to the northeast of NRC boring no. 38 (referred to in the RI as PVC-38 reflective of the existing PVC-casing installed by the NRC that was subsequently identified and located during the RI).

A total of 27 of the NRC borings were re-logged as part of the RI study. Table 2 lists and compares the results for the peak (highest) gamma readings obtained during the NRC and RI studies. For the most part the re-logging of the NRC borings during the RI yielded similar results to those observed by the NRC study; however, there were a few exceptions. The RI re-logging identified a distinct gamma peak in NRC boring 10 (PVC-10) at a depth of 10 ft bgs that was not identified by the earlier NRC logging of this boring. Similarly, the RI re-logging of NRC boring 12 (PVC-12) identified a distinct peak at a depth of 2.5 ft bgs that was not identified by the earlier NRC logging of this boring. Conversely, the NRC results indicate the presence of a slight gamma peak at a depth of 5 ft bgs but the subsequent RI re-logging did not identify the presence of elevated gamma readings at this depth interval. In addition, the depths at which some of the peak values were identified at some locations varied (between 1 to 3 ft) between the two studies (e.g., NRC borings 5, 7, 9, 25 and 33).

The results of the downhole gamma logging obtained by the NRC and RI studies from the generally but not strictly co-located soil borings were compared to assess the comparability of the data and potential variations in radionuclide activities in Areas 1 and 2. For example, downhole logging performed during the RI identified a peak gamma reading of 10,000 counts per minute (cpm) at a depth of 6.5 ft below ground surface (bgs) in WL-112. Downhole logging performed by NRC in NRC boring no. 38 identified a peak gamma reading of 5,000 cpm at a depth of 7 ft bgs. Re-logging of NRC boring no. 38 was performed through the PVC casing during the RI. This re-logging identified a peak gamma reading of 17,000 cpm at a depth of 8 ft bgs. All of the results of the gamma logging indicate the presence of radionuclides within the waste materials at a depth of approximately 6.5 to 8 ft bgs in the area of RI boring WL-112 and

NRC boring no. 38. Similarly, RI boring WL-209 was drilled approximately 25 ft to the south of NRC boring no. 4 and approximately 60 ft to the west of NRC boring no. 7. Downhole logging of RI boring WL-209 identified a peak gamma reading of 744,000 cpm at a depth of 0.5 ft. NRC logs for borings 4 and 7 identified gamma peaks of greater than 50,000 cpm at depths of 0 – 2 ft bgs in both borings. Relogging of these same two borings during the RI identified a gamma peak of 1,290,000 cpm at a depth of 1 ft bgs in boring 4 and 1,386,000 cpm at a depth of 3 ft in boring 7.

Review of the data presented on Table 2 indicates that a high degree of variability exists in the locations and intensity of the radionuclide occurrences in Areas 1 and 2. Both the NRC and the RI investigations identified the presence of elevated gamma readings in many of the proximal boring locations, at similar depth intervals with similar activity levels (e.g., WL-112/PVC-38, WL-114/PVC-26, WL-117/PVC-36, WL-209/PVC-4, WL-209/PVC-7, and WL-226/PVC-19) and in one instance (WL-222/PVC-34) both studies identified the absence of elevated gamma levels in the same general area. In other instances, elevated gamma levels were not found to be present in an RI boring drilled near an NRC boring that identified the presence of a gamma peak (e.g., WL-115/PVC-25, WL-118/PVC-26, and WL-227/PVC-40) or elevated gamma readings were identified in an RI boring in one area (WL-113/PVC-27) where elevated gamma readings were not found by the NRC study.

The causes of the differences in the description of the depth of contamination between the NRC and RI reports include:

- Differences between the locations of many of the RI soil borings compared to the NRC soil borings;
- Differences in the depth of the soil borings and/or the depth of gamma logging between the RI and NRC studies; and
- As discussed further below, the general lack of laboratory analytical data from the NRC study, in particular almost no data (field or laboratory) for Th-230 (8 surface soil samples the locations for most of which are unspecified and two subsurface samples the depths of which are unspecified in the NRC study), compared to the extensive soil sample analytical results (over 120 sample were subjected to laboratory analyses, not counting background, duplicate, or Ford property samples, including 48 samples from Area 1 and 74 samples from Area 2) obtained as part of the RI.

3.5 Radiological Characterization of the RIM

In general, the primary radionuclides detected in Areas 1 and 2 at levels above background concentrations are part of the Uranium-238 and Uranium-235 decay series. Thorium-232 and Radium-224 isotopes from the Thorium-232 decay series were also present above background levels but at a lesser frequency.

During the RI, a total of 134 soil samples, including 12 duplicate samples, were collected and submitted to an offsite laboratory for radionuclide analyses. This included 54 total samples (including 6 duplicate samples) from Area 1 and 80 total samples (including 6 duplicate samples) from Area 2. The maximum detected values for Radium-226, Thorium-230 and Uranium-238 reported for the RI samples obtained from Area 1 were 906, 9,700 and 147 pCi/g respectively. The maximum detected values for Radium-226, Thorium-230 and Uranium-238 reported for the RI samples obtained from Area 2 were 3,060 (duplicate result of 1,260), 57,300 (duplicate result of 12,000) and 294 pCi/g respectively. A complete listing of the RI analytical results is presented in the RI report.

The NRC characterization of the radionuclide activity levels was primarily based on the results of the downhole logging and resultant calculated values for individual radionuclide activity levels. Only two subsurface soil samples (the depths of which were unspecified) were obtained by the NRC and submitted to an offsite laboratory for radiochemical analyses and neither of these samples was analyzed for Radium-226. In addition, Radium-226 activity levels from soil borings drilled in Area 1 were not measured or calculated in the NRC study.

The highest Radium-226 activity value reported in of the NRC report was 440,000,000 (4.4 x 10^9) pCi/g for a sample obtained from the 18 ft depth from NRC boring No. 21 located in the southern portion of Area 2. This value appears to be incorrect and is not considered to be reliable as it is never discussed in the text of the NRC report and is inconsistent with the downhole gamma logging results obtained from this boring and depth interval. It would appear that this value may have been a typographical error. Based on the downhole gamma results and the results for the other radionuclides reported for this same depth interval, it appears that the Radium-226 activity likely was 4.4 pCi/g (4.4 x 10^0). The next highest Radium-226 value presented in the NRC report is 22,000 pCi/g obtained from the 2-ft depth interval in NRC boring No. 1; however, the location of this boring is not provided on any of the figures in the 1982 or 1988 NRC reports. Given the lack of documentation regarding the values and locations of the two highest Radium-226 results reported in the NRC study, the validity of these results is questionable.

The third, fourth, and fifth highest Radium-226 values reported in the NRC report are 15,000 pCi/g for the 1 ft depth sample in boring No. 3, 13,000 for the 2 ft depth interval in boring No. 11, and 11,000 pCi/g for the 15 ft depth sample in boring No. 16. These borings were located in the central and southern portions of Area 2. By comparison, the maximum reported Radium-226 activity level reported by the analytical laboratory in <u>any</u> of the 134 RI soil samples was 3,060 pCi/g found in the 10-ft depth sample obtained from boring WL-234 located in southern portion of Area 2. Accordingly, the RI-documented values for Radium-226 are an order of magnitude lower than the NRC reported values.

The highest Uranium-238 value listed in the NRC report is 2,900 pCi/g for the 2-ft depth in boring No. 11. In contrast, the maximum reported Uranium-238 activity level reported by the analytical laboratory in <u>any</u> of the 134 RI soil samples was 294 pCi/g found in the surface sample obtained from boring WL-209 located in north-central portion of Area 2. Similar to the Radium levels, the RI-documented values for Uranium-238 are an order of magnitude lower than the NRC report values.

In summary, the NRC report includes calculated radionuclide activities based on field measurements with only a very limited number of laboratory analyses for a very limited number of parameters. Consequently, the accuracy and precision of the NRC results cannot be assessed. Furthermore, with respect to some of the highest radionuclide results reported by the NRC, the available documentation is incomplete or the reported results are inconsistent with other data obtained by the NRC. In contrast, the RI results are based on over 100 analytical laboratory results obtained fifteen years later in accordance with EPA-approved analytical methods and quality control/quality assurance procedures for which the reported results include known accuracy and precision. The RI results do not support the Radium-226 and Uranium-238 activity levels presented in the NRC report. Given the questionable reliability of the NRC results compared to the more documented reliability of the RI results, evaluations of the nature and extent of contamination and potential risks has been performed using only the RI analytical results.

Overall, the findings and conclusions of the remedial investigation (RI) about the location and nature of the radioactivity at West Lake Landfill are in agreement with those reported by contractors to the U.S. Nuclear Regulatory Commission in the 1980s (NRC 1988; RMC 1981). Both investigations identified approximately the same two areas (so-called Radiological Disposal Areas 1 and 2) where radiologically impacted materials (RIM) are present at the Site. Both studies found that the radioactivity at the Site results from occurrences of uranium and its decay products and is dominated by thorium-230 and radium-226. Both studies determined that the levels of radium-226 at the Site are not in radioactive equilibrium with the levels of thorium-230 and, consequently, the levels of radium-226 are anticipated to increase during the next few hundred years as a result of decay of thorium-230. Both studies determined that the then-existing and expected future concentrations of radionuclides are significantly elevated, relative to proposed cleanup levels. Both studies determined that the subsurface occurrences of RIM extend beyond the limits of the surface occurrences of RIM. Finally, both studies concluded that the majority of the RIM is located within approximately 15 feet of the ground surface. For example, RIM was identified during the RI in Area 1 at depths generally ranging between 0 and approximately six feet in the northwestern portion (see RI at page 92) and between 0 and approximately 15 feet in the southeastern portion (see RI, at page 92) and with an average thickness of approximately three feet (see RI, at page 93). RIM was identified during the RI in Area 2 at depths generally ranging between 0 and approximately six feet in both the northern portion (see RI at page 97) and southern portion (see RI, at page 92) and with an average thickness of approximately four feet (see RI, at page 98). Due largely to the greater depth of the RI borings, the RI did identify occurrences of RIM at depths below 15 ft in several areas in Area 2.

3.6 Radionuclide Decay and Ingrowth

Radionuclides present in Area 1 and 2 are derived from Uranium-238and Uranium-235and its decay products. The primary decay products of concern are TThorium-230 and Radium-226 owing to the higher activity (concentration) levels, higher radiation levels, and/or longer half lives of these isotopes. Although the various studies of radionuclide occurrences at the West

Lake Landfill may have characterized different suites of radionuclides, all of the studies evaluated the nature and extent of Thorium-230 and Radium-226 and all identified the presence of these isotopes as the primary radionuclides of concern at the Site.

Results of all of the investigations of the site have identified that the activity level of Thorium-230 exceeds, and is not in equilibrium with that of the other radionuclides, notably, Radium-226. Consequently, as a result of decay of Thorium-230, the levels of Radium-226 are expected to increase over time as noted in the NRC reports (NRC, 1982 and 1988The projected increase in Radium-226 levels over time will be expected to result in both increased radiation levels and increased radon gas generation over time. The projected increase in radiation and radon levels over time were addressed as part of the risk characterization included the Baseline Risk Assessment (Auxier & Associates, 2000).

The increased radiation and radon gas emissions resulting from decay of Thorium-230 over time are also addressed in this SFS report. Specifically, the anticipated increase in radiation levels owing to increased Radium-226 levels over time was addressed by insuring that the new landfill cover was sufficiently thick so as to provide sufficient protection against the calculated levels of radiation resulting from in-growth of Radium-226 over time (1,000 years) from Thorium-230 decay. The increased levels of radon gas expected to occur as a result of in-growth of Radium-226 over time (1,000 years) from Thorium-230 decay were also addressed through use of the calculated radon emissions over time (1,000 years) to determine the thickness of the landfill cover required to attenuate radon emissions The thickness of the landfill cover for the on-site disposal cell alternative was also evaluated to address radon attenuation.

3.7 Principal Threat Waste Analysis

This subsection presents and evaluation of potential occurrences of Principal Threat Wastes in Areas 1 and 2.

3.7.1 Regulatory Background

The National Contingency Plan (NCP) establishes an expectation that treatment will be used to address the principal threats posed by a Site whenever practicable [section 300.430(a)(1)(iii)(A)]. EPA experience with site remediation indicates that certain source materials are best addressed through treatment because of technical limitations to the long-term reliability of containment technologies, or the serious consequences of exposure should a release occur (EPA, 1991a).

The concept of principal threat waste and low level threat waste as developed by EPA in the NCP is to be applied on a site-specific basis when characterizing source material (EPA, 1991a). Source material is defined as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, to surface water, to air, or acts as a source for direct exposure (EPA, 1991a). Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or which would present a significant risk to human health or the environment should exposure occur (EPA, 1991a). They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds (EPA, 1991a). No threshold level of toxicity/risk has been established to equate to "principal threat"; however, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be evaluated (EPA, 1991a). Low level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of a release (EPA, 1991a).

The identification of principal and low level threats is made on a site-specific basis. Determination as to whether a source material is a principal or low level threat waste should be based on the inherent toxicity as well as a consideration of the physical state of the material (e.g., liquid), the potential mobility of the waste in the particular environmental setting, and the stability and degradation products of the material. Wastes that generally will be considered to constitute principal threat wastes include, but are not limited to:

- Liquids – waste contained in drums, lagoons or tanks, free product (NAPLs) floating on or under groundwater (generally excluding ground water) containing contaminants of concern.

- Mobile source material – surface soil or subsurface soil containing high concentrations of contaminants of concern that are (or potentially are) mobile due to wind entrainment, volatilizations (e.g., VOCs), surface runoff, or sub-surface transport.

- Highly toxic source material – buried drummed non-liquid wastes, buried tanks containing non-liquid wastes, or soil containing significant concentrations of highly toxic materials.

Wastes that generally will be considered to constitute low level threat wastes include, but are not limited to

- Non-mobile contaminated source material of low to moderate toxicity – surface soil containing contaminants of concern that generally are relatively immobile in air or ground water (i.e., non-liquid, low volatility, low leachability contaminants such as high molecular weight compounds) in specific environmental settings.

- Low toxicity source material – soil and subsurface soil concentrations not greatly above reference dose levels or that present an excess cancer risk near the acceptable risk range.

In some situations, site wastes will not be readily classifiable as either principal or low level threat waste, and thus no general expectations on how best to manage these source materials of moderate toxicity and mobility will necessarily apply (EPA, 1991a). In these situations wastes do not have to be characterized as either one or the other. The principal threat/low level threat waste concept and the NCP expectations were established to help streamline and focus the remedy selection process and not as a mandatory waste classification requirement (EPA, 1991a).

3.7.2 Prior Site Determinations Regarding Principal Threat Wastes

Evaluation of potential occurrences of principal threat wastes at OU-1 was performed in conjunction with the initial February 2000 draft Feasibility Study (FS) report (EMSI, 2000a) and the subsequent September 2000 evaluation of potential "hot spot" removal (EMSI, 2000b). Both of these evaluations concluded that the radiologically-impacted materials at the site were not principal threat wastes. These same evaluations were included in subsequent drafts of the FS report (EMSI, 2002, 2004, and 2005) and in the final FS report (EMSI, 2006) that was accepted by EPA and used as a basis for development of the Proposed Plan and Record of Decision.

EPA subsequently determined in the Record of Decision that no principal threat wastes are present at the site (EPA, 2008). EPA found that the hazardous substances present in OU-1, including the radionuclides, are dispersed in a heterogeneous mix of municipal solid wastes. The preamble to the NCP identifies municipal landfills as a type of site where treatment of waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in CERCLA municipal landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. EPA has established source containment as the presumptive remedy for CERCLA municipal landfill sites. In appropriate circumstances, excavation and/or treatment of "hot spots" should be evaluated. Such an evaluation was previously performed for OU-1 and is presented in the original Feasibility Study (FS) report.

3.7.3 Additional Evaluations of Potential Principal Threat Wastes

The potential for occurrence of principal threat wastes (PTW) was re-evaluated in this SFS. The factors listed in EPA's 1991 guidance on PTW, as described above, were used to evaluate the potential for occurrence of PTW in OU-1 at West Lake Landfill.

<u>Liquid</u> – OU-1 contains municipal solid wastes including household wastes, construction and demolition debris, and possibly industrial wastes. Reportedly, 8,700 tons of leached barium sulfate residue were mixed with 39,000 tons of soil and transported to the site for use as daily and intermediate cover in the solid waste landfill operation. This material was a solid and there is no information indicating or suggesting that any radiological material was disposed in liquid form, was containerized, or otherwise may occur as a liquid waste.

<u>Mobility of Source Material</u> – The groundwater monitoring data show no evidence of significant leaching and migration of radionuclides from Areas 1 and 2. The vast majority of the groundwater monitoring results are consistent with background concentrations. Only two wells exhibited a total Radium concentration slightly above the EPA drinking water maximum contaminant level (MCL) of 5 pCi/l with values ranging from 5.74 to 6.33 pCi/l. These occurrences are spatially isolated and not indicative of the presence of a plume or definable area

of groundwater contamination. Perched water samples obtained from within the landfilled waste were sampled and analyzed and were not found to contain elevated concentrations of radionuclides. This is the case even though the waste materials have been in place with nearly flat surface grades and without a landfill cover for over 30 years. In other words, significant leaching and migration of radionuclides to perched water or groundwater have not occurred despite the fact that the landfill wastes have been exposed to worst-case leaching conditions (i.e., maximum precipitation and surface water infiltration due to nearly flat surface grades and absence of a landfill cover) over a period of decades.

The potential for future leaching to groundwater was also evaluated during the Remedial Investigation (RI) (EMSI, 2000c). A dominant factor influencing the transport and environmental fate of contaminants is the sorption-desorption process. Desorption or leaching is the process whereby molecules attached to the solid phase (in this case soil) are mobilized into the dissolved phase in water. Sorption is the process by which the molecules become or remain attached to the solid phase (soil). The degree to which a molecule is sorbed onto the soil or is leached into water is characterized by the distribution coefficient, a factor that relates the concentration sorbed onto a solid with the concentration in water in contact with that solid. The distribution coefficient values for radionuclides are relatively high, consistent with the tendency of radionuclides to remain in the soil or sediment phases rather than leaching into the water phase. Partitioning calculations using site data were presented in the RI. The calculated radionuclide concentrations based on the distribution coefficient are consistent with the groundwater sampling data collected during the RI. These calculations, along with the results of the groundwater monitoring results, support the conclusion that even in the absence of an infiltration barrier (e.g, landfill cover), impacts to groundwater over time are likely to be low.

Radionuclides generally have relatively low solubility in water and instead display an affinity to adsorb onto the soil matrix. Uranium does possess a greater solubility than that of the other radionuclides. Uranium has been detected in groundwater samples obtained from Site monitoring wells at levels of approximately 5 pCi/l or less. Uranium has been detected in upgradient, background wells at levels up to approximately 2 pCi/l. EPA has established an MCL of 30 ug/l (approximately 30 pCi/l) for Uranium in public drinking water supplies. The Uranium in the barium sulfate residue is insoluble in water; that is, the Uranium cannot be leached from the barium sulfate using water alone. Consequently, significant levels of Uranium are not expected to occur and have not been found in groundwater at the site.

Radionuclides can be transported to the atmosphere either as a gas in the case of radon or as fugitive dust in the case of other radionuclides. Both potential pathways were evaluated in the RI/FS based on site-specific data. Radon flux measurements were made at 54 locations in Areas 1 and 2. Although several locations reported high radon flux measurements, the average radon flux across Areas 1 and 2 was relatively low. The average radon flux from Areas 1 and 2 under current conditions with no landfill cap in place is less than the standard (20 pCi/m^2s) that is considered safe for tailings piles at Uranium mill tailings sites (40 CFR 192.02(b)). Release of radon is likely an exposure concern only in the hypothetical event someone occupied a building or structure on or immediately adjacent to Areas 1 and 2. Existing land-use covenants prohibit construction of buildings on Areas 1 and 2. The potential for radon emissions is easily mitigated with containment via a landfill cover.

During the RI fugitive dust monitoring was performed at locations that contain the highest radionuclide concentrations in surface soil samples. Analysis of these samples indicated that fugitive dust is not a significant pathway for radionuclide migration from Areas 1 and 2. Fugitive dust is not considered a significant pathway for radionuclide migration under current conditions, primarily because the surfaces of Areas 1 and 2 are, for the most part, vegetated. The potential for fugitive dust migration is easily mitigated with containment via a landfill cover.

Toxicity of the Source Material - There is no evidence of buried drums of non-liquid wastes or buried tanks containing non-liquid wastes in the waste materials in West Lake Landfill Areas 1 and 2. However, the radiologically contaminated soils mixed with the solid waste contain significant concentrations of naturally occurring radionuclides from the Uranium (U-238), Thorium (Th-232) and actinium (U-235) decay series.

As part of the RI, extensive surface and subsurface investigations were performed. Investigations included overland gamma surveys and an extensive soil boring and soil sampling and analysis program to characterize the distribution and extent of radiological and non-radiological constituents. Twenty borings were completed in Area 1 and forty borings were completed in Area 2. Isotopic analysis was performed on soil samples that were collected at various depth intervals that generally correlated with elevated gamma readings as measured in downhole radiological surveys. Soil analytical results were compared to reference levels derived from the soil cleanup standards in 40 CFR 192 (5 pCi/g surface and 15 pCi/g subsurface for Radium-226 or Radium-228). Maximum concentrations of some radionuclides were found to be high relative to the reference levels used in the RI (e.g., Thorium-230 greater than 10,000 pCi/g, Radium-226 greater than 1,000 pCi/g and Uranium-238 greater than 200 pCi/g). The investigations also determined that the distribution of radionuclide occurrences is quite variable and the numbers of detections in this range are small. The soil sample analytical results indicate that the average concentrations of radionuclides greater than 5 pCi/g plus background (e.g., 94 pCi/g for Thorium-230, 33 pCi/g for Radium-226 and 16 pCi/g for Uranium-238) in Areas 1 and 2 are generally more in range with reference levels.

A prior investigation conducted by the Nuclear Regulatory Commission (NRC) drilled and logged 39 soil borings including 10 borings in Area 1 and 29 borings in Area 2 (NRC, 1982). Based on its investigations, the NRC reported the presence of Radium-226 levels of up to 22,000 pCi/g (NRC, 1982 and 1988). As discussed in Sections 3.4 and 3.5, above, the location of the NRC soil boring (boring no. 1) from which the 22,000 pCi/g value was reportedly found could not be determined from the information provided in the NRC reports. Furthermore, the NRC studies did not perform radiochemical analyses of soil samples to determine the levels of Radium-226 or other radionuclides present in Areas 1 and 2. The NRC study logged representative boreholes using an in situ gamma measurement system consisting of an intrinsic germanium (IG) detector coupled to a multichannel analyzer to perform quantitative and qualitative field analyses. Finally, review of the NRC report indicates that problems were encountered in the use of this system. Specifically, the 1982 NRC report states "The field use of this system was somewhat limited by initial failure due to high humidity effects on the pre-amp components and thermal insulation of the detector housing. These problems were partially corrected by sealing the detector in an outer container and allowing dry air to flow through the container." Data generated by such field analyses may be inaccurate given that the report notes the problems were only "partially corrected", and are not of the same quality as data generated by radiochemical analyses at an offsite, EPA-certified analytical laboratory. Results of the RI sampling and offsite laboratory analyses of soil samples failed to re-produce the Radium-226 levels reported in the NRC report. A total of 48 and 73 soil samples were obtained from Area 1 and 2, respectively as part of the RI investigations (not counting field or laboratory duplicate samples or background samples). The highest Radium-226 level found in all of the RI soil samples was 3,720 pCi/g. The next highest samples contained Radium-226 levels of 3,060 pCi/g (duplicate sample reportedly contained 1,260 pCi/g), 2,970 pCi/g (duplicate sample reportedly contained 3,140 pCi/g), and 2,280 pCi/g. The vast majority of the samples contained Radium-226 levels in the range of less than 1 pCi/g to less than 20 pCi/g. Given the noted problems with the field measurement during the NRC study, it is inappropriate to draw conclusions regarding the toxicity of the source material using the results of unconfirmed field analyses reported in the NRC study.

It is also important to factor in risk analysis since the health threats posed by these radionuclides are a function not only of the concentration of the radionuclides but also the manner and time period during which someone might become exposed. The radionuclides came from processed ore residues, and the ratio of Th-230 to Ra-226 is much greater than would be the case if these radionuclides were in equilibrium. Therefore, the calculations of potential risk presented in the baseline risk assessment were adjusted for ingrowth of Ra-226 and its eight daughters from decay of Th-230 over a 1,000 year period.

The Baseline Risk Assessment (BRA) (Auxier & Associates, 2000) looked at potential exposure scenarios based on reasonably anticipated land use including groundskeepers and other workers using Areas 1 and 2 for storage or other ancillary purposes. Under the assumption that radionuclides remain at or near the ground surface, some exposure to these workers would occur. The assessment used standard exposure factors and toxicity values to estimate the health risks to these hypothetical workers. Exposure frequencies and routes of exposure vary depending on the nature of the job. Exposure duration, or the time a worker remains in the job, was assumed to be 6.6 years.

Consistent with EPA risk assessment guidance (EPA, 1989), the assessment of radiological health risks was limited to carcinogenic effects. Carcinogenicity is assumed to be the limiting deleterious effect from low radiation doses. The calculated risks are expressed in terms of increased lifetime cancer risk to the exposed individual. Under most scenarios, the calculated cancer risks are within EPA's acceptable risk range defined as 1×10^{-4} or 1 in 10,000. However, under two future receptor scenarios, the grounds keeper and the storage yard worker, the individual lifetime cancer risk was calculated to be 2×10^{-4} and 4×10^{-4} respectively, slightly exceeding the acceptable risk range. These calculated risks were based on calculated future (1,000 year) Radium concentrations of 3,224 and 3,653 pCi/g for Areas 1 and 2 respectively. The calculated risks do not meet the 10^{-3} risk level criteria set forth in EPA's 1991 guidance for identification of principal threat wastes.

<u>Can the waste material be reliably contained</u> - At the West Lake Landfill Site OU-1, the municipal wastes were placed above grade. The surface elevation of the site at OU-1 is 20 to 30 feet or more above the level of the historic flood plain. Most of the radiologically contaminated

materials occur in the upper half of the waste fill. There is no means for water to contact the radiologically contaminated materials except through surface infiltration.

Capping through the use of engineered covers is a well understood and routinely applied technology that forms a barrier between the contaminated material and the surface. Multi-layer, natural material cover systems are effectively used to mitigate the release of radon gas, minimize water infiltration, and remain effective for long periods of time (EPA 2007).

The engineered landfill cover included in the ROD-selected remedy will be designed to prevent surface water from contacting and potentially leaching the waste material. Surface grading and run-on/run-off controls would be used to shed surface water and divert it from the disposal areas. A low permeability layer would also be incorporated to further mitigate the potential for surface water infiltration. Installation of the cover system would reduce or eliminate any perched water that currently exists within the landfill.

When caps are used to contain Radium contaminated materials they are typically designed to confine gaseous radon until it has essentially decayed. Such systems are used to contain long-lived radionuclides at large Uranium mill tailing sites where radon generation is a much greater concern than at the West Lake Site due to the vast amounts of tailings involved. Because radon decays rather rapidly (Ra-222 has a half life of 3.8 days), vertically migrating gas only needs to be detained for a relatively short period of time for the radon to decay. The engineered landfill cover included in the ROD-selected remedy will be designed and constructed with sufficient thickness of natural materials to attenuate radon. Under the selected remedy, radon measurements at the surface of the cap should be indistinguishable from background.

<u>Conclusion</u> - The radiological source material in West Lake Landfill OU-1 is not liquid; it is relatively immobile in this environmental setting; it is of low to moderate toxicity; and it can be reliably contained. Based on the considerations provided in the EPA guidance (EPA, 1991), the radiological source materials at the site are more similar to low level threat wastes than to principal threat wastes.

<u>Treatment</u> - Consistent with the NCP, EPA's expectation is that source containment technologies generally would be appropriate for municipal landfill waste because the volume and heterogeneity of the waste material generally make treatment impracticable.
This expectation is also established by the EPA directive "Presumptive Remedy for CERCLA Municipal Landfill Sites" (EPA, 1993), and EPA's "Guidance for Performance of RI/FS at CERCLA Municipal Landfill Sites" (EPA, 1991b).

In a subsequent directive "Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills" (EPA, 1996), EPA provided guidance on the application of the presumptive approach to military landfills. Generally, the presumptive approach is appropriate for military landfills that are similar to municipal landfills but may also have low-hazard military specific waste, such as low-level radioactive wastes, which are generally no more hazardous than some of the industrial or hazardous wastes frequently found in CERCLA municipal landfills. In many cases, these hazardous chemical substances (e.g., industrial wastes containing chlorinated solvents) are much more toxic and more mobile in the environment than the radionuclides found in Areas 1 and 2.

Consistent with the expectations in the NCP and related guidance for landfills, treatment to reduce toxicity, mobility, or volume is not considered practicable for the West Lake RIM. Most contaminants within Areas 1 and 2 are dispersed within soil material that is further dispersed throughout the overall matrix of municipal refuse and construction and demolition debris. The large scale and heterogeneous nature of the waste materials make excavation of the radiologically impacted materials for possible *ex-situ* treatment techniques impracticable. In addition, there are no *in-situ* treatment technologies that can be applied to this circumstance. Hot spots - According to the presumptive remedy guidance for CERCLA Municipal Landfills (EPA, 1993), the decision to characterize and/or treat hot spots is a site-specific judgment that should be based on a standard set of considerations. These considerations are highlighted below. As specified in the presumptive remedy guidance document, the overriding question is whether the combination of characteristics is such that leaving the waste in place would threaten the reliability of the containment system.

If all of the following questions can be answered in the affirmative, it is likely that characterization and/or treatment of hot spots is warranted:

1. Does evidence exist to indicate the presence and approximate location of waste?

2. Is the hot spot known to be principal threat waste?

3. Is the waste in a discrete accessible part of the landfill?

4. Is the hot spot known to be large enough that its remediation will reduce the overall threat posed by the site but small enough that it is reasonable to consider removal (e.g., 100,000 cubic yards or less)?

Based on extensive field investigation and evaluation, the nature and location of the radiological source material at OU-1 is well known. However, the answer to all other questions is negative. As discussed above, for the various criteria used to evaluate the potential for a principal threat waste, the radiological source material would be characterized as low level threat waste rather than principal threat waste. Accordingly, containment is a reliable and appropriate technical approach. Moreover, the radionuclides are dispersed within soil material that is further dispersed throughout the overall, heterogeneous matrix of municipal refuse and construction and demolition debris. Analysis of the RI boring data indicates that the vertical distribution of the radionuclides is highly variable and irregular, even over short horizontal distances. This type of distribution is not consistent with the condition that the waste be present in a discrete and accessible location. The volume of material that would need to be removed depends on whether sorting of the waste material is considered practical or economical. In any event, the volume of material that would need to be removed to recover a majority of the radiological contamination is several times larger than 100,000 cubic yards. As such, there are no hot spots in Areas 1 and 2 requiring characterization and treatment.

EPA Additional Comments Nos. 5, 6 (partial), 10, 17 (partial), 21, 28, and 29 and MDNR 15, 16, 17, 88 and 116 – Site, Groundwater, Waste, Land-Use Conditions and Buffer Zone/Crossroad Property

Comments

EPA Additional Comment No. 5

5. The final document should also explicitly reconcile the data and findings of the RI with the data, primary findings, and conclusions about hydrology and groundwater in the two NRC reports described more fully in comment 2 above, including:

- "Studies indicate the landfill is on the alluvial floodplain of the Missouri River." (1982 report at p. 3). "About 75 percent of the landfill site is located on the floodplain of the Missouri River" (1988 report at p. 5) "contamination of water in the bedrock aquifer is possible" and "*The water table of the Missouri River floodplain is generally within 10 feet of the ground surface, but at many points it is even shallower.* At any one time, the water levels and flow directions are influenced by both the river stage and the amount of water entering the floodplain from adjacent upland areas" (emphasis added) and "This represents the likely direction of leachate migration from the landfill." (1988 report, p. 6).

- "Any possibility of disposal on site will depend on adequate isolation of the waste from the environment, especially for protection of the groundwater. It is unclear whether the area's groundwater can be protected from onsite disposal at a reasonable cost." (1988 report at p. 14).

The final report needs to address how these statements affect potential leaching within the existing landfills, as well as potential for enhancing the mobility of hazardous substances into groundwater from the landfills. Section 2 would be a logical location for this discussion and a summary of pertinent, site-specific hydrologic and hydrogeologic information.

EPA Additional Comment No. 6

6. Groundwater conditions should be described in greater detail in Sections 2 and 5.2, respectively.

- The final document should acknowledge that interpreting flow conditions and contaminant sources is complicated due to the hydrologic/geologic setting (e.g., perched ground water has been observed), operation of the leachate collection system for the Former Active Sanitary Landfill, and other man-made influences (e.g., Earth City and levee maintenance).

- The description of groundwater quality conditions should identify all constituents that have been detected in groundwater at concentrations greater than their respective MCLs. In particular, the final report should address the MCL exceedences (e.g., Radium) identified in the ROD (see Table 5-1).

NOTE: The above list includes only portions of EPA Additional Comment 6 as other portions of this comment have previously been addressed as part of the responses to EPA Additional Comment 3 or various comments related to the Environmental Monitoring Plan.

EPA Additional Comment No. 10

10. The final document should provide a full, accurate and up-to-date accounting of evidence, if any, that significant quantities of potentially hazardous wastes and asbestos-containing materials are present in Areas 1 and 2 and should include a coherent, internally consistent evaluation of related (e.g., hazardous waste and mixed waste) issues. In particular, the final document needs to fully characterize and identify RCRA hazardous wastes (e.g., metals; solvents) and discuss the RCRA subtitle C regulations as a potential ARAR for proper disposal of such hazardous wastes. The presence of hazardous waste may pose significant implementation problems, could impose significant costs regarding the excavation alternatives, and would prompt the need for changes in the identification and evaluation of related ARARs (in Section 3).

EPA Additional Comment No. 17

17. To help make this document more self-sufficient and "reader-friendly," Section 2 (suggested title: Summary of Key Site Conditions) should include concise, coherent presentations of the full range of site-specific information that potentially bears upon an evaluation of the alternatives. On that basis, the document at a minimum should include in Section 2:

   - a readily identifiable sub-section that consolidates the dispersed information about surrounding land use (i.e., background information reported in Sections 2.1, 3.1.2.2.1, 5.3.4.1, and elsewhere in the draft). Such a dedicated sub-section would provide a good opportunity to identify and illustrate the proximity of the airport and orientation of its runways and the proximity of residential neighborhoods.

   - additional information and potentially also clarifications about the nature and location of current on-site operations (e.g., explain why a solid waste transfer station and borrow area are essential to current site operations if wastes are no longer disposed on site; modification of Figure 2 to clarify Site boundaries and identify undeveloped area(s) of the Site). Such information would provide a foundation for the subsequent discussion of possible candidate locations for a newly constructed on-site disposal unit, as envisioned in one of the excavation alternatives.

- existing land use and ground water use restrictions for the Site, including the Negative Easement and Declaration of Restrictive Covenants Agreement mentioned on page 24 of the draft.

- a summary of the design and construction of the two non-active landfills, known as Radiological Areas 1 and 2, and evidence, if any, about the generation of methane within or underneath these landfills.

- a summary of pertinent, site-specific information about ground water (see, for example, comments 5 and 6 above).

- available information about seismic areas, Holocene faults, unstable areas, and wetlands (as cited in state landfill siting regulations [10 CSR 80-3.010(4)(b)]), which pertain to each of the remedial alternatives being evaluated.

  Additional information about transportation routes (e.g., truck routes into and out of the site, location of nearest railroad line) and truck traffic (e.g., number of trips into and out of site under current operations, if available) might also warrant inclusion in Section 2 to provide a basis/context for subsequent discussions and evaluations about community impacts of the excavation alternatives (i.e., "short-term" effectiveness) and infrastructure needs of the excavation alternatives.

NOTE: The last paragraph of EPA Additional Comment No. 27 is being addressed separately.

EPA Additional Comment No. 21

21. The Negative Easement is documented in the SFS (Appendix B), presumably because it potentially bears upon the implementation of the alternatives being evaluated in the SFS. The existing on-Site land use restrictions should also be documented in an appendix to the final SFS, because the information bears upon evaluations of the long-term effectiveness, reliability, and protectiveness of the alternatives being evaluated in the SFS.

EPA Additional Comment No. 28

28. As stated in the 1988 NRC report (*Radioactive Materials in the West Lake Landfill*, NUREG Publication 1308, page 1), the NRC during a site inspection in 1974 determined that approximately "43,000 tons of waste and soil", comprised of leached barium sulfate residues mixed with top soil had been disposed in 1973 at the West Lake Landfill and "covered with only about 3 feet of soil.." This same NRC report notes that this landfill

"was closed in 1974 by the Missouri Department of Natural Resources (MDNR)." This contemporary reference (and/or other contemporary references), rather than the 2009 report by TtEMI, needs to be cited as the basis for information summarized in the SFS about the operating history of the non-active landfills known as Radiological Areas 1 and 2.

EPA Additional Comment No. 29

29. The draft SFS needs to accurately describe the extent and timeframe for solid waste disposal activities (including non-radioactive solid wastes) in the non-active landfills known as Radiological Areas 1 and 2; as written, the draft SFS suggests they were limited to the early 1970s. The sub-section about operational history needs to clarify:) the overall operating period; and, 2) the design and construction of these two non-active landfills and whether they satisfy the current, primary design criteria for a RCRA Subtitle C or D landfill.

MDNR Section-Specific Comment No. 15

15.) Section 2 SITE CONDITIONS, page 6 - This section does not discuss non-radiological contamination. An overview of the chemicals of concern detected in the remedial areas should be provided.

MDNR Section-Specific Comment No. 16

16.) Section 2.1 Site and Surrounding Area Land Uses, page 6 - This section does not mention residential land use in the surrounding area such as the Spanish Village residential area. Also, it does not include information on possible groundwater use of the surrounding area. Any city or county ordinances prohibiting installation of drinking water wells in proximity of the site should also be identified. It was also noted that Area 2 and the Closed Demolition Landfill were zoned "residential" in Figure 2-5 of the OU-1 Feasibility Study and that requests have been made to change this zoning. Please provide follow-up information on this aspect.

MDNR Section-Specific Comment No. 17

17.) Section 2.1 Site and Surrounding Area Land Uses, page 6 - The document states "These operations were not subject to state permitting because they occurred prior to formation of the MDNR in 1974." It may be more accurate to state the operation occurred prior to laws and regulations regulating such operations.

MDNR Section-Specific Comment No. 88

88.) Section 6.2.1.3.2 Adequacy and Reliability of Controls, page 93 - The first sentence of the second paragraph states, "Covenant restrictions have been recorded by each of the owners against their respective parcels and the entire West Lake Landfill (including Areas 1 and 2 and the soil borrow/soil stockpile area) prohibiting residential and groundwater use." Please list the owners, parcel information, and include copies of the covenant restrictions in the SFS. The next sentence states, "Construction work, as well as commercial and industrial uses, has been precluded on Areas 1 and 2 by a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc., prohibiting the placement of buildings and restricting the installation of underground utilities, pipes and/or excavation upon its property." Please include a copy of this covenant as well in the SFS.

MDNR Section-Specific Comment No. 116

116.) Figure 4: Extent of Radiologically Impacted Material - Please show the radioactive contamination on the Buffer Zone/Crossroad property.

Discussion

Per direction from EPA Region 7 relative to preparation of the draft SFS, evaluations and discussions presented in the Remedial Investigation (RI) and Feasibility Study (FS) reports (EMSI, 2000 and 2006) were not repeated or summarized in the SFS. In response to these comments, Section 2 of the EPA-approved FS (EMSI, 2006) that describes the site conditions will be included as part of the SFS report and augmented as necessary to address these comments.

The revised Section 2 will also be augmented to address other comments (e.g., EPA Additional Comments Nos. 17, 28, and 29 and MDNR Section-Specific Comments No. 16, 17 and 88) relative to existing land uses at and in the area of the site and existing restrictions on land uses at the site.

SFS Text Revisions

A revised Section 2 – Site Conditions is attached to this response to comments.

EPA FEEDBACK:

The approach to addressing these multiple comments is acceptable, and the text of the revised Section 2 is also acceptable. However, Figure 12 appears to be incorrect.

EPA Additional Comments Nos. 11, 12, 13, 26, and 38 – Report Organization

Comments

EPA Additional Comment No. 11

11. The opening sentence of the Introduction (Section 1) should clarify the purpose of the document, which is reflected by the following sentences: "As a result of its internal deliberations and its further consideration of certain comments provided by interested community members, EPA determined that a Supplemental Feasibility Study (SFS) is warranted. This SFS will be added to the Administrative Record for this Site."

EPA Additional Comment No. 12

12. Section 1.1 might be more appropriately entitled "Scope" if the relevant discussions about scope are consolidated therein. On that basis, the first sentence of Section 1 should be moved to become the opening sentence in Section 1.1 and the first two complete paragraphs on page 3 (about NCP requirements) should be moved to Section 1.1. In addition, Section 1.1 should note the following: "Among other things, this document refines the description and evaluation of the containment remedy that was selected in the ROD. It also addresses in detail various facts and findings contained in two NRC reports that evaluate this Site."

EPA Additional Comment No. 13

13. If the changes recommended in comment 12 above are made, then Section 1.2 might be more appropriately entitled "Approach." On that basis, the second sentence of Section 1 should be moved to become part of the opening of Section 1.2.

EPA Additional Comment No. 26

26. Because the Statement of Work was primarily conceptual and does not displace or change any statutes, regulations or guidance, it does not represent a comprehensive, final statement about the scope or approach of the SFS or the scope of EPA's considerations in making remedy selection decisions. The final SFS should not include any statements that compare and contrast the Statement of Work and the final Work Plan, nor should it include any statements that could be construed as criticizing or identifying a shortcoming in the Statement of Work. (For example, the second complete paragraph on page 3 opens with "Although not required by the SOW (EPA, 2010), the NCP requires …" The phrase "Although not required by the SOW (EPA, 2010)" is unnecessary and could be misleading.)

EPA Additional Comment No. 38

38. The final report should minimize unnecessary, duplicative information. For example, the history of this document's development (i.e., letters and workplans) is repeated throughout the draft (see, for example, introduction to Sections 2.3 and 4.2, in addition to opening paragraph of Section 1), as are statements that the "complete rad removal" alternative wouldn't really remove the radioactive materials completely (see, for example, page 1, second paragraph of Section 2.2.2, and fourth paragraph of Section 3.1.1.1.1) and that EPA required two additional alternatives to be evaluated (see, for example, last sentence in Section 1.1 and introduction to Section 4.2, in addition to third paragraph of Section 1.1). As a general matter of style and readability, non-critical information of this kind need not be restated repeatedly throughout a document.

Discussion

The additional information and re-ordering suggested by EPA Additional Comments Numbers 11, 12 and 13 have been made to the Introduction. The suggested change to Section 1 presented in EPA comment No. 26 has also been incorporated into a revised version of Section 1.

With regard to the items that EPA Additional Comment Number 38 identified as redundancies, we do not agree that the document would benefit from removal of all of the identified items.

For example, the brief discussion in the first paragraph of Section 2.3 is not considered to be unnecessary or duplicative. This discussion documents a change in the approach to locating an onsite disposal cell that EPA made after issuance of the SOW. The SOW specified the following requirement for the "Complete Rad Removal" alternative "...if feasible, the cell should be located outside the historic geomorphic floodplain." Based on the SOW language, an on-site cell located within the historic geomorphic floodplain could have been considered in the SFS. EPA subsequently clarified this requirement to indicate that a "Complete Rad Removal" alternative with on-site disposal alternative should *only* be evaluated "if a suitable location outside of the geomorphic floodplain can be identified." This change in the approach to the on-site disposal option needed to be documented in the SFS. Given that this change related to a very specific aspect of the SFS, which is, evaluation of the location of the historic geomorphic floodplain relative to identification of potential locations for a new onsite disposal cell, it was most appropriate to document this change in approach at the start of Section 2.3.

With respect to Section 4.2, Section 4 (now renumbered as Section 5 due to other changes in the SFS report) presents a summary of the technology evaluation from the FS, followed by additional evaluation of technologies associated with the "complete rad removal" alternatives. A brief introduction of the two "Complete Rad Removal" alternatives was included in the draft SFS to provide a transition from the summary of the prior technology evaluations to the evaluations of additional technologies associated with the two "Complete Rad Removal" alternatives. In response to this comment, the discussion of the two "Complete Rad Removal" alternatives presented at the beginning of former Section 4.2 has been eliminated (see response to EPA Additional Comment No. 31).

The nature of the cleanup levels and the fact that even under the "Complete Rad Removal" alternatives, residual radioactive material below the cleanup levels will remain on site, was extensively discussed during development of the SFS Work Plan. At that time, EPA indicated that the SFS should clearly indicate that the "Complete Rad Removal" alternatives would not, in fact, remove all radionuclide occurrences from the landfill. Therefore, a statement to this effect was added to the introduction section of the SFS. To avoid ambiguity and to provide clarification in the SFS, it was necessary to include this qualifier as part of the discussion of the cleanup levels to be used for the "Complete Rad Removal" alternatives (originally found in Section 2.2.2 but moved to near the end of Section 4 – ARARs in the revised draft SFS document currently in process). We could not find where similar language was presented in the fourth paragraph of Section 3.1.1.1.1 as suggested by the comment. There is language in the third paragraph of Section 3.1.1.1.1 stating that "...even if a "complete rad removal" alternative were to implemented, waste materials would still remain on site thereby requiring institutional controls." This statement does not highlight the fact that even under the "Complete Rad Removal" alternatives, radionuclides below cleanup levels would remain on site. Instead it indicates that even if one of the "Complete Rad Removal" alternatives were to be implemented, waste materials (i.e., solid wastes) would remain on site and the presence of these wastes necessitates maintenance of the existing institutional controls and possible implementation of additional institutional controls to protect the landfill cap and to ensure that only those future uses that are compatible with the presence of a solid waste landfill occur at the site.

SFS Text Revisions

A revised Section 1 – Introduction is attached.

EPA FEEDBACK:

EPA accepts this response and the proposed text revisions.

Responses to Comments on Evaluation of Alternatives Criteria and Other Miscellaneous Comments

- EPA Specific Comments Nos. 4 and 26
- MDNR Comments Nos. 78, 96, 99, 100, and 103

EPA Specific Comment No. 4

Comment

4. Section 2.2.3, page 13: This section should explain what a "bank cubic yard" is and how it differs from a "loose cubic yard." Also, the arithmetic calculating the "Total RIM" figure is incorrect; the value should be 335,500 bcy.

Discussion

A "bank cubic yard" refers to the volume of an in-place, undisturbed material such as soil or refuse. Conversely, a "loose cubic yard" refers to a volumetric measurement of material when it is in a loose state after it has been excavated. When material is excavated, it typically swells relative to its in-place volume. For example, a "bank cubic yard" of soil will typically occupy 20 to 30 percent less volume than a "loose cubic yard" of soil, and a "bank cubic yard" of refuse may occupy up to 60 percent less volume than a "loose cubic yard" of refuse. For purposes of estimating quantities in the SFS, it was assumed that a "bank cubic yard" of combined overburden and RIM (matrix of soil and refuse) in Areas 1 and 2 would occupy 50 percent less volume than a "loose cubic yard"

Regarding the sum of Area 1 and 2 RIM, the correct value is 335,500 bcy.

Proposed Revisions to the SFS Report

The following changes will be made to the third paragraph under Section 2.2.3:

Based on these evaluations, the total volumes of RIM contained in Areas 1 and 2 were estimated as follows:

Area 1 RIM	33,500 bank cubic yards (bcy)
Area 2 RIM	302,000 bcy
Total RIM	335,500 bcy

Note: A "bank cubic yard" refers to the volume of an in-place, undisturbed material such as soil or refuse. Conversely, a "loose cubic yard" refers to a volumetric measurement of material when it is in a loose state after it has been excavated. When material is excavated, it typically swells relative to its in-place volume. For example, a "bank cubic yard" of soil will typically occupy 20 to 30 percent less volume than a "loose cubic yard" of soil, and a "bank cubic yard" of refuse may occupy up to 60 percent less volume than a "loose cubic yard" of refuse. For purposes of estimating quantities in the SFS, it was assumed that a "bank cubic yard" of combined overburden and RIM (matrix of soil and refuse) in Areas 1 and 2 would occupy 50 percent less volume than a "loose cubic yard"

EPA Specific Comment No. 26

Comment

26. Section 6.2.1.6.2, page 97: This section is titled "Reliability of the Technology" but it does not actually evaluate its reliability, stating only that this technology is used frequently. A more robust line of evidence demonstrating the reliability of this technology must be included.

Discussion

Landfill cover system technology, as reflected in current State and Federal landfill regulations and guidance for design, construction, and post-closure care to achieve the following performance objectives associated with waste disposal sites: 1) minimizing percolation and infiltration of precipitation; 2) minimizing leachate generation; 3) minimizing impacts to groundwater quality; 3) minimizing impacts to surface water quality and quantity; 4) minimizing erosion of cover material; and 5) minimizing uncontrolled releases of landfill gas. In addition, the security systems that would be implemented (e.g., gating, fencing, and routine surveillance) are reliable mechanisms to prevent unauthorized access to the site, thereby helping preserve the long-term integrity of the final cover system.

Additional discussion of the reliability of this technology is provided in conjunction with the responses to EPA Specific Comment 44. Additional information regarding the reliability of this and the other technologies is included in the revised Sections 6.2.1.6 regarding the implementability of the ROD-Selected Remedy, Section 6.2.2.6 regarding the implementability of the "Complete Rad Removal" with off-site disposal alternative, and Section 6.2.3.6 regarding the implementability of the "Complete Rad Removal" with on-site disposal alternative.

Proposed Revisions to the SFS Report

Section 6.2.1.6.2 will be replaced with the following text:

> Landfill cover systems that are designed and constructed consistent with State and Federal regulations and whose post-closure care is implemented in accordance

with current regulatory guidance have been demonstrated to be reliable at 1) minimizing percolation and infiltration of precipitation; 2) minimizing leachate generation; 3) minimizing impacts to groundwater quality; 3) minimizing impacts to surface water quality and quantity; 4) minimizing erosion of cover material; and 5) minimizing uncontrolled releases of landfill gas. In addition, security systems would be implemented that include gating, fencing, and routine surveillance. These are reliable mechanisms to prevent unauthorized access to the site.

MDNR Comment No. 78

Comment

78.) Section 6.1.7.1 Capital and Operation, Maintenance, and Monitoring Costs, page 83 - The documents states that cost to treat water could be significant, even though no analysis is provided. Please provide an analysis of on-site vs. off-site water treatment. The cost to ship water to an off-site facility for treatment could be significant and other sites within the state have successfully treated water generated under similar conditions on-site. The on-site disposal cell option may have additional water treatment needs that should be considered and compared.

Discussion

As stated in the third bulleted paragraph on page 83 insufficient precipitation volumes, flow rates and removal requirements are available to establish a reasonable basis of design that would allow for a comparative analysis of treatment costs for each of the alternatives. This is because the amount of precipitation water that contacts RIM for each alternative cannot be determined with confidence, nor can the treatment cost for radionuclide removal. Rather, it can only be assumed that if radionuclides were to be removed from accumulated precipitation waters, some combination of chemical and physical treatment processes, coupled with solids handling to manage a concentrated sludge from the treatment processes that would contain radionuclides, would be required. These treatment trains are typically expensive – both from capital and O&M perspectives. Because RIM excavation would result in creation of irregular surfaces which would increase the potential for ponding of stormwater under either of the "Complete Rad Removal" alternatives, there is a greater potential for accumulation of stormwater and consequently greater potential cost associated with treatment of stormwater under the two "Complete Rad Removal" alternatives. Prediction of the amount of stormwater that would accumulate under any of the alternatives requires development of detailed design documents that are beyond the scope of a Feasibility Study. Consequently, for purposes of the SFS, costs for treatment were assumed to be relatively high but similar for the three alternatives Therefore, the last sentence in the subject paragraph is appropriate and no further analysis of treatment costs is warranted for this SFS.

Proposed Revisions to the SFS Report

No revisions will be made to the referenced paragraph.

MDNR Comment No. 96

Comment

96.) Section 6.2.2.6.2 Reliability of the Technology, page 108 - This section should include more discussion of other sites that have implemented remedies similar to the off-site disposal alternative proposed in this SFS such as the FUSRAP.

Discussion

The following describes the status of sites that were or are currently being remediated under DOE's Formally Utilized Sites Remedial Action Program (FUSRAP) where radioactive contamination remained from the Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations. This information was obtained from DOE's web site http://www.lm.doe.gov/pro_doc/references/framework.htm#cercla.

DOE determined that 46 sites required remediation. DOE remediated 25 sites by 1998; thereafter, the U.S. Congress directed the U.S. Army Corps of Engineers (USACE) to remediate the remaining 21 sites. Remediation of FUSRAP sites followed Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) protocols. Most of the sites required some form of excavation with offsite disposal in licensed low-level radioactive waste disposal facilities.

Most FUSRAP sites have been remediated to conditions that pose no risk to human health and the environment under any future use scenario. With regulatory concurrence, these sites have been released for unrestricted use. No ongoing surveillance is required.

The Office of Legacy Management (LM) currently manages the following FUSRAP sites that have been remediated:

Acid/Pueblo Canyon, New Mexico, Site
Adrian, Michigan, Site
Albany, Oregon, Site
Aliquippa, Pennsylvania, Site
Bayo Canyon, New Mexico, Site
Berkeley, California, Site
Beverly, Massachusetts, Site
Buffalo, New York, Site

Chicago North, Illinois, Site
Chicago South, Illinois, Site
Chupadera Mesa, New Mexico, Site
Columbus East, Ohio, Site
Fairfield, Ohio, Site
Granite City, Illinois, Site
Hamilton, Ohio, Site
Indian Orchard, Massachusetts, Site
Jersey City, New Jersey, Site
Madison, Illinois, Site
Middlesex North, New Jersey, Site
New Brunswick, New Jersey, Site
New York, New York, Site
Niagara Falls Vicinity Properties, New York, Site
Oak Ridge, Tennessee, Warehouses Site
Oxford, Ohio, Site
Seymour, Connecticut, Site
Springdale, Pennsylvania, Site
Toledo, Ohio, Site
Tonawanda North Units 1 and 2, New York, Site
Wayne, New Jersey, Site

The following sites are owned by DOE and are undergoing remediation by USACE:

Colonie, New York, Site
Maywood, New Jersey, Site
Middlesex Sampling Plant, New Jersey, Site
Niagara Falls Storage Site, New York

Fact sheets that describe the remediation programs and status of all of these FUSRAP sites can be downloaded at: http://www.lm.doe.gov/land/sites/fusrap/fusrapmain2.htm

It must be noted that to the best of our knowledge, none of these sites were landfill sites or involved excavation of municipal solid wastes.

Proposed Revisions to the SFS Report

The following paragraph will replace the current text in Section 6.2.2.6.2:

> Excavation and off-site disposal of radioactively-impacted material has been performed at other facilities and is a reliable technology. For example, DOE's Formally Utilized Sites Remedial Action Program (FUSRAP) involved the remediation of 46 sites where radioactive contamination remained from Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations. Most of the sites required some form of excavation with offsite disposal in

licensed low-level radioactive waste disposal facilities. Most of the sites have been remediated to conditions that pose no risk to human health and the environment under any future use scenario. With regulatory concurrence, these sites have been released for unrestricted use. For more information about these sites, see http://www.lm.doe.gov/land/sites/fusrap/fusrapmain2.htm. It should be noted, however, that none of these FUSRAP sites involved radiological materials commingled with municipal solid waste and disposed in a landfill setting.

NOTE: Other extensive revisions to this section are being prepared in response to EPA comment No. 44.

Reference

See: http://www.lm.doe.gov/pro_doc/references/framework.htm#cercla.

MDNR Comment No. 99

Comment

99.) Section 6.2.3.3 Long-Term Effectiveness and Permanence, page 113 - The description of the lined engineered cell needs discussion on the benefit of a bottom liner to prevent leaching to groundwater.

Discussion

The liner system of the engineered cell would also prevent migration of leachate from emplaced material into underlying groundwater.

Proposed Revisions to the SFS Report

The following sentence will be inserted after the fifth sentence of the first paragraph in Section 6.2.3.3:

> The liner system of the engineered cell would also prevent migration of leachate from emplaced material into underlying groundwater.

MDNR Comment No. 100

Comment

100.) Section 6.2.3.3.2 Adequacy and reliability of controls, page 114 - This section needs discussion on adequacy and reliability of engineering and institutional controls for the onsite disposal cell.

Discussion

Adequacy and reliability of controls applies to the engineered containment systems as well as institutional controls. Consequently, the additional text below will be added to this section.

Proposed Revisions to the SFS Report

The following paragraph will be inserted as a new paragraph before the existing text:

> The on-site engineered cell, in conjunction with long-term O&M, is a reliable containment system that would be expected to be protective of human health and the environment. Long-term O&M would include routine cover and storm water ditch inspection and service, if necessary, to mitigate erosion; O&M of a landfill gas collection and treatment system, as needed; and routine servicing of a leachate collection system. Long-term monitoring would also be implemented to assess compliance with environmental performance standards. The performance of these engineering controls would also be reevaluated during statutory five-year reviews.

NOTE: Other extensive revisions to this section are being prepared in response to EPA comment No. 44.

MDNR Comment No. 103

Comment

103.) Section 6.2.3.6.2 Reliability of the Technology, page 119 - This section needs discussion about other sites that have used containment of radiologically contaminated material according to UMTRCA standards. A discussion of the reliability of the technology at these sites would be beneficial.

Discussion

Extensive revisions to this section are being prepared in response to EPA comment No. 44.

Proposed Revisions to the SFS Report

This section is being revised in response to both this comment and EPA Specific Comment No. 44. A revised section is being provided in conjunction with the response to EPA comment No. 44.

EPA FEEDBACK:

EPA accepts these responses and proposed text changes; need to review the revisions being made in response to EPA comment 44 as well to make sure the overall section is acceptable.

EPA Specific Comments Nos. 15 and 38 –Waste Acceptance Monitoring and CERCLA Offsite Disposal Rule

Comments

EPA Specific Comment No. 15

15. Section 4.3.1, page 40: The fifth paragraph should discuss waste acceptance monitoring for hazardous constituents and asbestos in addition to scanning the waste for the radiological waste acceptance criteria.

EPA Specific Comment No. 38

38. Section 6.2.2.6.7, page 109: This section must state whether or not the three disposal facilities meet the criteria under the Off-Site Rule to accept CERCLA waste from this site. EPA Region 7 contacted EPA Regions 8 and 10 to determine the current compliance status of the Energy Solutions and US Ecology facilities, and found that both were currently in compliance. These compliance determinations are renewed every 60 days.

Discussion

All three turnkey transportation and off-site disposal facility companies have indicated that as part of the transportation and disposal service, they will monitor and test the waste materials to determine whether the materials as loaded into the containers meet the radiological acceptance criteria and to determine if the wastes would be classified as hazardous wastes. These companies indicated that they are required to do this monitoring in order to meet the requirements of their state-issued RCRA permits. The text of Section 4.3.1 will be revised to reflect this.

The text will be expanded to indicate that during development of the SFS, EPA Region VII determined that the offsite disposal facilities were found to be in compliance and therefore met the criteria under the Off-Site Rule to accept CERCLA waste. The text will also be modified to indicate that such determinations are made on a regular basis every 60 days and that the compliance status of any offsite disposal facilities would need to be re-evaluated during remedial design and would need to be regularly evaluated and updated during remedy implementation.

SFS Text Revisions

Revised Fifth Paragraph of Section 4.3.1 Short-term Monitoring During Construction

If excavated RIM would be disposed off-site, waste acceptance monitoring would entail scanning each load of material removed from the site to verify that the radiological Waste Acceptance Criteria of the facility where the RIM would be disposed is met. The material would also be inspected and tested as necessary to determine whether the waste materials contain or could be classified as hazardous wastes. Discussions with potential disposal facilities indicate that they would conduct these inspections and testing including providing the necessary personnel and equipment as such testing is a requirement of their RCRA permits.

6.2.2.6.7 Availability of Off-site Treatment, Storage and Disposal Services and Capacity

As discussed in Section 4.3.7, three off-site disposal facilities that could accept excavated RIM from the West Lake Landfill OU-1 have been identified. All three facilities have accepted similar radiologically impacted waste from projects or sites in the United States and have available capacity to accept the estimated volume of RIM from the site. The volumetric rate of acceptance for all facilities would be limited by the number of gondola railcars that could be loaded at or near the site as well as the number that could be unloaded at or near the disposal facility.

These facilities are also able to accept liquid wastes, should any stormwater accumulated in excavations during RIM excavation become contaminated and require disposal off-site.

As discussed in Section 3.2.1, the CERCLA Off-site Rule requires that waste materials removed from a CERCLA site only be placed in a facility operating in compliance with RCRA or other applicable Federal or State requirements. During development of the SFS, EPA Region VII determined that the offsite disposal facilities were found to be in compliance and therefore met the criteria under the Off-Site Rule to accept CERCLA waste. EPA makes such determinations every 60 days. The compliance status of an offsite disposal facility would need to be re-evaluated during remedial design and would need to be regularly evaluated and updated during remedy implementation.

EPA FEEDBACK:

EPA only checked the CERCLA Off-Site Rule status of the EnergySolutions and US Ecology facilities, not the Clean Harbors Deer Trail facility, as it appeared that the Clean Harbors facility was not a viable alternative due to the Rocky Mountain LLRW Compact. In any case, the proposed sentence in Section 6.2.2.6.7 beginning with "During development of the SFS…" presents outdated information and should be deleted.

Solids Separation Comments

- EPA Specific Comment No. 17
- EPA Additional Comments Nos. 33 and 46
- MDNR Section-Specific No. 53

EPA Specific Comment No. 17 and Additional Comments 33 and 46

Comments

17. Section 4.3.3, page 42: The last paragraph of this section should note that a pilot test of these solids separation technologies would be required during the remedial design phase of either of the "complete rad removal" alternatives, should one of those remedial alternatives be selected. In addition, in the fourth sentence, the word "exceeded" should be "exceeding".

33. Additional explanation or clarification may be warranted to provide assurance that shredding is a suitable pre-treatment step to facilitate size separation of waste materials. The current draft states that "shredders would be employed as a pretreatment step prior to a solids separation process" (See Section 4.1.2, page 41). Because such a pre-treatment would tend to reduce the size of municipal solid waste materials, it could be counter-productive as a treatment step in advance of solids separation processes that primarily rely upon differences between small soil particles and larger pieces of solid waste, such as are cited in Section 4.3.3 (see pages 41-42).

46. Page 114, last paragraph: The draft report does not describe what consideration was given to separating the trash from the radioactive material to have less volume of waste to dispose. The final report needs to fully and accurately address this issue. The final document should consider various techniques to reduce waste volume.

MDNR Section-Specific No. 53

Comment

53.) Section 4.3.3 Solids Separation, page 42 - The document concludes that segregation of RIM could not be assessed at this time. The Department considers volume of RIM an important variable in overall comparisons of alternatives. Please provide an analysis of segregation of wastes. Additional characterization information defining the nature of the wastes (debris vs. RIM) may be needed to perform this analysis.

Discussion

Numerous volume reduction approaches were considered, as discussed in Sections 4.3.2 and 4.3.3 of the SFS. In particular, Section 4.3.3 (Solids Separation) discussed the use of hand-picking for large bulky items, magnetic separation for ferrous metals and contaminants associated with ferrous metals, eddy current separation for non-ferrous metals, air classification for papers and plastics, and various screening techniques including the use of rotating trommel screen separators.

Full-scale pilot testing of the shear shredder/trommel screen solids separation equipment for volume reduction would definitely be required using representative material from Areas 1 and/or 2 prior to remedial design. Pilot testing is typically performed prior to landfill mining and reclamation (LFMR) projects in order to assess screening and trommel equipment sizing, estimate production rates, determine the fraction of soil that can be separated from the filled material using varying trommel screen opening sizes (and therefore maximizing the amount of soil that can be removed), and obtain an indication of the type of material that was filled (e.g., construction and demolition debris such as bricks, concrete and rebar, dimensional lumber and/or municipal solid waste). Of particular interest in pilot testing of material from Areas 1 and 2 would be the moisture content of the filled material and the fraction of soil that are contained in or adhered to the segregated refuse.

Regarding the use of shear shredders prior to trommel screens, based on discussions with trommel screen manufacturers, shear shredders are always used as a pretreatment step prior to screen separation for three primary reasons. The first is that an approximate 30 percent volume reduction in waste material is achieved by shredding all filled material to a uniform 6 to 8-inch size. Subsequently separated material that is returned to the landfill is more easily compacted and takes up less volume than the original in-place waste material. (It should be noted that very large landfilled objects such as white goods and steel beams, etc. are "hand-picked" from the waste stream prior to shredding.) A second reason for shredding pretreatment is to break-up pockets and clumps of organic and matted materials and soil; dislodge smaller materials that may be 'hidden" in amongst larger materials; and pulverize materials such as mattresses, brick, concrete block, and large chunks of concrete that contain rebar to provide a stream of more uniformly-sized material so that fines and the soil fraction of the waste can be more easily separated. Finally, shear shredding reduces the size of materials (primarily from construction/remodeling and demolition of structures, and roads; including rebar and other pieces of steel, dimensional lumber and columns/beams, plumbing fixtures and piping, recycled asphalt, and electrical wiring and components) that would tend to clog, get hung up in, and increase the wear on the trommel screen and flights. The benefits or impacts of using a shear shredder prior to a trammel screen relative to maximization of separation of radiologically-impacted soil from solid wastes would need to be evaluated as part of a pilot-test.

Proposed Revisions to the SFS Report

Sections 4.3.2 and 4.3.3 will be rewritten as follows:

4.3.3 Solids Separation

Solids separation processes can include hand picking for large bulky items and hazardous materials such as propane tanks, magnetic separation for ferrous metals and contaminants associated with ferrous metals, eddy current separation for non-ferrous metals (e.g., inducing an electric current to separate aluminum cans from other recyclables), air classification for papers and plastics, and various fixed, vibrating, or rotating screens. Trommel (revolving cylindrical sieve) screens are commonly used during landfill mining and reclamation (LFMR) projects to separate materials by size, with the soil fraction passing through the screen. In some cases, a bar screen is used prior to the trammel screen as a first pass gross size separation. Metal conveyor flights on the inside surface of the screen direct the non-soil fraction to the discharge end of the rotating cylinder. The size and type of screen used depends on the end use of the recovered material. If the radiologically-impacted soil were to be separated from the landfilled waste materials, one or more mobile diesel-driven trommels would be used downstream of a shear shredder. A 1 to 1½-inch screen size would likely be chosen to recover the most soil while passing through small pieces of metal, plastic, glass, and paper.

During LFMR projects, trommel screens are typically used downstream in series with a shear shredder with the recovered soil fraction directed to one side of the trommel. This configuration of shear shredder and trommel in an LFMR pilot-test application is shown in Figure 9.

Although it is expected that use of the shear shredder/trommel equipment would be effective at separating the majority of soil from the non-soil solid waste, the degree of separation that may be achieved by this technology is uncertain. Prior applications of this technology have been focused on separating the bulk of the soil volume from an overall matrix of landfill wastes in order to implement waste-to-energy or waste composting operations or to recover the soil for reuse. These applications were not designed or expected to recover 100% of all of the soil in a landfill and were not concerned with the fractions of soil that were contained in or adhered to the segregated refuse. These applications also were not concerned with the creation of additional fine-grained fractions that would become mixed with the recovered soil as a result of use of a shear-shredder prior to a trammel. Consequently, the effectiveness of this technology at separating RIM, and only RIM from the overall mass of solid wastes cannot be determined without performance of a pilot-test.

In Areas 1 and 2 of the West Lake Landfill residual soil containing radionuclides that adheres to or is otherwise contained in the refuse after performance of waste segregation using a trommel could still produce processed waste exceeding the cleanup criteria. As a result, the effectiveness of this technology is uncertain. Furthermore, although a trommel includes an exterior brush (Figure 9) to remove debris that may otherwise become entangled in the rotating screen, there would still be instances in which laborers would have to enter the screen and physically remove wire, rebar, plastic, wood, or other entangled debris. During these events, workers would be exposed to increased radiation emitted by RIM that adheres to or otherwise remains in the trommel. The frequency and duration of physical removal of debris cannot be estimated at this time; however, it is clear that use of a trammel would create an additional mechanism for worker exposures to the RIM. Consequently, the potential effectiveness and implementability of this technology relative to segregation of RIM from non-RIM cannot be assessed.

Depending upon the production rate and dependability of the solids separation equipment, inclusion of a solids separation step as part of a process used for excavation and disposal of the RIM could become a factor relative to the daily production rates and project duration. In addition to the additional activities requiring workers and resultant exposures, use of such equipment could extend the overall project schedule and increase the potential or amounts of stormwater accumulation, airborne emissions, bird or other vector impacts due to a possible increase in the overall schedule.

In order to evaluate the this technology, full-scale pilot testing of the shear shredder/trommel screen solids separation equipment for volume reduction would definitely be required using representative material from Areas 1 and/or 2. Pilot testing is typically performed prior to LFMR projects in order to assess screening and trommel equipment sizing, estimate production rates, determine the fraction of soil that can be separated from the filled material using varying trommel screen opening sizes (and therefore maximizing the amount of soil that can be removed), and obtain an indication of the type of material that was filled (e.g., construction and demolition debris such as bricks, concrete and rebar, dimensional lumber and/or municipal solid waste). Of particular interest in conducting pilot testing of material from Areas 1 and 2 would be obtaining an estimate of the degree of RIM volume reduction that could be achieved, assessing the moisture content of the filled material, and determining the fraction of soil that would be contained in or adhered to the segregated refuse.

<u>EPA FEEDBACK:</u>

<u>EPA accepts this response and the proposed text revisions.</u>

EPA Specific Comment No. 23 – On-Site Cell Design

Comment

EPA Specific Comment No. 23

23. Section 5.3.4.2, page 66: This section notes that the design of the on-site cell would primarily be based on the UMTRCA requirements, while considering the requirements of the MDNR solid waste regulations to the extent that they do not compromise the UMTRCA requirements. It is not clear that the multiple synthetic components of the on-site cell's proposed liner and cap design would meet the design life requirements of UMTRCA. In addition, the proposed granular drainage layer in the cap is a potential plane of weakness along which the upper layer of the cap could fail and slump off the landfill at some point during the UMTRCA-specified design life. These issues must be addressed in this section and in the detailed analysis of this alternative in Section 6.

Discussion

Design of the onsite cell is based primarily on the MDNR solid waste regulation requirements, but also includes a rock/concrete rubble layer to address the longevity requirement of UMTRCA. This will be clarified in the revised text as presented below.

Evaluation of the performance of the onsite cell relative to potential long-term risks, and design of the landfill cover pursuant to UMTRCA requirements relative to gamma radiation and radon emissions, were both performed without consideration of any potential benefits that may accrue from inclusion of a geomembrane in the landfill cover. Consistent with the longevity requirements of UMTRCA (40 CFR 192.02), these evaluations were also performed based on the maximum expected gamma radiation levels and radon emissions calculated to occur within a 1,000 year period as a result of decay and ingrowth of the radionuclides present in OU-1. This will be clarified in the revised text as presented below.

As required by the MDNR solid waste regulations (10 CSR 80-3(17)(C)4.B.(II)) the design of the landfill cover for the new cell includes a granular drainage layer between the vegetative layer and the underlying geomembrane liner. Although the granular drainage layer theoretically could represent a plane of potential shear failure, the intended purpose of the drainage layer would be actually to maintain the stability of the cover slopes by eliminating pore water pressures above the low-permeability layer (EPA, 1993 and 1994). Therefore, the presence of the sand drainage layer should actually increase the long-term stability of the landfill cover. The stability of the landfill cover would be evaluated as part of the remedial design and as required by the MDNR solid waste regulations (10 CSR 80-3(17)(C)5).

Changes will also be made to detailed analysis of this alternative presented in Section 6 of the draft SFS consistent with the discussion and revised text prepared for this comment.

SFS Text Revisions

5.3.4.2 General Configuration of On-site Cell

Both the MDNR solid waste regulations and UMTRCA requirements were considered during preparation of a conceptual design for an on-site engineered cell. Site selection and suitability requirements established under both of these regulations were reviewed and evaluated relative to the potential location. As the new cell would be constructed on-site, no permits would be required; however, in accordance with the NCP, the substantive requirements of the siting and permitting portions of these regulations would be considered during the conceptual design. The final design for a new on-site cell would primarily be based on the MDNR Solid Waste Regulations (10 CSR 80-3.010) but also incorporate features to address requirements of UMTRCA (40 CFR 192.02).

The on-site cell would consist of an engineered liner and a final cover consistent with the MDNR solid waste regulations (10 CSR 80-3(10) and 10 CSR 80-3(17)). In addition to the MDNR solid waste regulation requirements, a rock/concrete rubble layer is also included in the final cover design to address the longevity requirements of UMTRCA. The intended purpose of the rock/rubble layer is to:

- Reduce the potential for biointrusion into the underlying waste materials;
- Provide a marker layer to identify the materials as artificial deposits/waste materials; and
- Serve as a final barrier against erosion into or of the underlying waste materials.

The design of the landfill cover for a new on-site disposal cell was also evaluated to ensure that it would be sufficiently thick to reduce potential risks from exposure to gamma radiation from the underlying waste materials and to ensure sufficient radon attenuation so as to meet the radon emissions ARAR of UMTRCA. Consistent with the longevity requirements of UMTRCA, evaluations of the required cover thickness were performed based on the maximum expected gamma radiation and radon emission levels calculated to occur over the next 1,000 years.

The liner design would consist of the following components from the bottom layer up:

- Foundation layer or subgrade;
- 2-ft thick low permeability earthen liner ("clay" layer);
- 60 mil high density polyethylene (HDPE) geomembrane;
- 16 oz/sq yd cushioning geotextile;
- 1-ft thick leachate drainage layer; and
- Separation geotextile.

The final cover system would consist of the following components from the waste layer up:

- 2-ft thick biointrusion layer;
- 1.3-ft thick low permeability earthen layer ("clay" layer);
- 40 mil low density polyethylene (LDPE) geomembrane;
- 1-ft thick granular drainage layer; and
- 2-ft thick protective soil and vegetative layer.

A profile of the liner and cover systems for the on-site cell is provided as Figure 15.

References

U.S. Environmental Protection Agency, 1994, Seminar Publication – Design, Operation, and Closure of Municipal Solid Waste Landfills, EPA/625/R-94/008, September.

U.S. Environmental Protection Agency, 1993, Solid Waste Disposal Facility Criteria, EPA 530-R-93-017, November.

EPA FEEDBACK:

As the original comment states, the synthetic components of the proposed liner and cap are unlikely to last 1,000 years, which is the UMTRCA cap design life. The revised Section 5.3.4.2 needs to explicitly acknowledge this fact, and discuss to what extent (if any) the expected failure of these synthetic components during the 1,000 year UMTRCA design life will compromise the ability of the proposed liner and cap to contain the waste, attenuate radon emanation, and shield against radiation. Also, the rationale for including the drainage layer, as provided in the "Discussion" above, should be added to the revised Section 5.3.4.2.

EPA Specific Comment No. 42 and MDNR General Comments Nos. 54 and 63 – On-site Cell Capacities

Comments

EPA Specific Comment No. 42:

42. Section 6.2.3.6.1, page 118: As discussed during our meeting on July 15, 2010, the size of the soil stockpile area being considered for the new on-site cell is "just barely" large enough to accommodate the expected volume of RIM from Areas 1 and 2. This section should evaluate the effect on the implementability of this remedy should the volume of RIM be found to exceed the capacity of the on-site cell during its construction.

MDNR General Comment No. 54

54.) Section 4.3.6 New On-Site Disposal Cell, page 44 - The first sentence of this section states, "The 'complete rad removal' with on-site disposal alternative would involve construction of an engineered cell of sufficient volume to contain excavated RIM from Areas 1 and 2 with a liner system that meets MDNR solid waste management plan (SWMP) regulations and a cover system that meets SWMP and UMTRCA requirements." Please change "solid waste management plan" to "Solid Waste Management Program". Also please include in this statement a description that the liner and cover should include leachate and gas collection systems and gas and groundwater monitoring systems. Also, the cell design should be developed and described based on the longevity requirements of UMTRCA.

MDNR General Comment No. 63

63.) Section 5.3.4.1 Siting of On-site Cell, page 64-65 – It was noted during review that the potential on-site disposal cell location is located south of the on-site storm-water retention pond. As the apparent groundwater flow direction on the West Lake Landfill site is to the south, it is possible the groundwater in this area could be mounded and potentially impact the placement of the base of the liner or the leachate collection system, as well as the West Lake Landfill OU-1 geologic stability of the soils in the potential location. Please consider this during siting of the on-site disposal cell.

Discussion

The SOW requires evaluation of a "Complete Rad Removal" with on-site disposal alternative. The SOW also required that a new engineered disposal cell included in this alternative be located outside of the geomorphic floodplain. As discussed in the draft SFS, the only undeveloped portion of the West Lake Landfill property that is located outside of the geomorphic floodplain for location of a potential on-site cell, is the area that contains the Bridgeton Landfill's on-site soil borrow area and soil stockpile area. As this area is located outside and away from areas investigated by the OU-1 and OU-2 RI field investigations, little to no information is available regarding subsurface conditions (e.g., depth to groundwater or soil stability). Investigation of subsurface conditions in this area is beyond the scope of the SFS. Consequently, site conditions in this area have been extrapolated from information obtained from other parts of the site or assumptions have been developed as needed to prepare a conceptual design for a new engineered on-site disposal cell. The validity of these extrapolations and assumptions could affect the feasibility and/or cost of construction of an engineered disposal cell at this location.

The soil borrow/stockpile area includes an approximately 32-acre area located to the east of the former active sanitary landfill and south of the site stormwater management pond and the Bridgeton Landfill/hauling company yard area. Currently, the area is undeveloped with the exception of a portion that is used to stockpile soil for post-closure care of the former active sanitary landfill and as potential cover soils for remedial actions for OU-2.

For the conceptual design of an on-site cell, it was envisioned that a 10-acre facility could be located within the available property without significant cutting and filling while still leaving available area for additional stormwater management facilities. A buffer zone of at least 100 feet would be necessary between the property line and the cell to comply with MDNR requirements and allow for perimeter road and construction of environmental monitoring facilities (e.g., landfill gas and groundwater monitoring wells).

Although the scope of previous hydrogeologic investigations did not include this area, extrapolation of the nearest available piezometric surface data from the northeast corner of the adjacent Subtitle D landfill indicate that the average piezometric surface elevation of the potential on-site cell area may be on the order of approximately 465 feet MSL. Site selection regulations in 10 CSR 80-3.010(4)(B)8. regarding landfill liner location relative to groundwater specify *"If the base of the landfill liner will be in contact with groundwater, the applicant shall demonstrate to the Department's satisfaction that the groundwater will not adversely impact the liner"*. In an email dated March 16, 2011, David Johnson of MDNR indicated that MDNR has an internal policy requiring a one-foot separation between a new cell liner and the underlying groundwater.

The conceptual design of the on-site cell included in the draft SFS envisioned that the top of the cell liner would vary between elevations 466 feet to 480 feet MSL. The top of waste elevations (bottom of the final cover) would vary between 472 feet MSL and 524 feet MSL. The conceptual design provided for an available volume of 448,000 bank cubic yards (bcy), or an average waste depth of approximately 28 feet. The final cover for the cell would be designed with a maximum slope of 25% and minimum slope of 5%.

The volume of the on-site cell, according to the current design assumptions, would be sufficient to allow for the disposal of the RIM as well as the daily cover soil volumes currently expected to be needed during the RIM relocation efforts. An estimated 335,000 bcy of RIM would be excavated from Areas 1 and 2 of OU-1 and an additional 7,000 bcy of soil would be excavated from the Buffer Zone/Crossroad Property under this alternative. Therefore, 342,000 bcy of RIM and impacted soils would require disposal. During relocation, daily cover soils would be required to be applied to the exposed wastes in the excavation areas and the relocated wastes in the on-site cell. It was assumed in the draft SFS analysis that a daily cover soil volume equal to 10% of the volume of the RIM/soil that would be relocated would be needed for the exposed wastes in the excavation areas, and another 10% of the volume of RIM/soil that would be relocated would be needed for daily cover on the relocated wastes in the on-site cell. Based on these assumptions, it is estimated that a total of 20% by volume of RIM/soil that would be relocated would be needed for daily cover, or approximately 68,000 bcy. Therefore, the necessary minimum volume required of the on-site cell to accommodate the estimated volumes of RIM from Areas 1 and 2, soil from the Buffer Zone/Crossroad Property, and daily cover soil would be approximately 410,000 bcy.

Consequently, for the contemplated design of the on-site cell included in the draft SFS, approximately 38,000 bcy excess capacity could be available in the on-site cell (448,000 bcy cell capacity minus 410,000 bcy RIM/soil/daily cover), in case the estimated volume of RIM or associated daily cover increases during the remedial design or during construction. This excess capacity is less than ten percent of the total volume of RIM/Soil/daily cover that is estimated to require relocation to the on-site cell. Additionally, it should be noted that no subsurface geological and geotechnical field investigations have occurred in the area proposed for the on-site cell, and piezometric surface data are not available. If the piezometric surface elevation under the potential on-site cell location is greater than the estimated 465 feet MSL, in order to comply with the MDNR policy requiring a one-foot separation between new cell liner and the underlying groundwater, the elevation of the new cell liner would have to be raised. For the area of the on-site cell assumed in the draft SFS, every 1 foot increase in liner elevation would reduce the available fill volume in the on-site cell by approximately 16,000 bcy (i.e., a volume equal to a one foot height over a 10-acre area). If the elevation of the new cell liner needs to be raised by 2.3 feet, excess cell capacity would no longer be available.

There are a few design alternatives available to increase the estimated capacity of the on-site cell. The alternative that would yield the largest additional capacity would involve relocating significantly more soil borrow and stockpiled soil than envisioned in the on-site cell conceptual design in the draft SFS, extending the limit of the on-site cell further to the north, and increasing the cell area. Under this scenario, approximately 70,000 bcy of additional airspace would be gained, increasing the estimated capacity of the on-site cell to 558,000 bcy. This increased capacity would accommodate a thirty-five percent (35%) increase in the estimated 410,000 bcy RIM/soil/daily cover volume to be relocated. However, if the on-site cell liner grades would need to be elevated and/or the RIM/soil/daily cover volume would be substantially greater, some of the unanticipated RIM/soil/daily cover volume could require disposal off-site.

SFS Text Revisions

Section 6.2.3.6.1 would be rewritten as follows:

6.2.3.6.1 Ability to Construct and Operate the Technology

All of the liner and cover materials as well as the equipment and personnel to construct the on-site cell are readily available and the technology has been proven through application at other landfills. Design and construction of the cell liner and cover would not be expected to pose any technical implementability challenges. Excavation and placement of RIM in the on-site cell would be expected to present some implementability challenges, specifically those associated with the excavation and handling of contaminated materials; management of fugitive dust and potential odor; mitigation of bird hazards; management and treatment of stormwater exposed to the RIM during excavation; and identifying, segregating, and disposing off-site of any hazardous materials, including asbestos, encountered during RIM excavation. Directing and controlling the RIM excavation using scanning and sampling techniques will greatly restrict excavation production rates.

The conceptual design for the on-site cell contemplated in this SFS assumes that an approximate 10-acre area located outside of the geomorphic floodplain in the undeveloped portion of the West Lake Landfill property in the area that contains an on-site soil borrow area and soil stockpile would be the only potentially suitable area for constructing an on-site cell. Geological and geotechnical field investigations and piezometric surface data collection to determine site suitability would be completed as pre-design studies during remedial design. If the results of the pre-design investigations indicate that the assumed location for the on-site cell is not suitable, then this alternative would not be implementable.

The estimated available landfill disposal volume in the on-site cell conceptual design is based on a bottom liner elevation that is situated at the minimum allowable separation from extrapolated information on the piezometric surface in this area. However, since the on-site cell area was not within the scope of past hydrogeologic characterization studies, there is more uncertainty in the piezometric conditions, and the actual conditions will influence the bottom grades of the on-site cell. For example, if the measured piezometric surface elevation under the proposed location for the on-site cell is 2.3 or more feet higher than the elevation assumed, the capacity of the on-site cell could be insufficient to accommodate the total volume of relocated RIM from Areas 1 and 2, radiological soil from the Buffer Zone/Crossroad

Property, and daily cover needed during RIM excavation and placement in the on-site cell. Insufficient on-site cell volume would require that some RIM be disposed off-site. Similarly, if the RIM volume excavated during implementation of the remedial action for this alternative is significantly greater than the RIM volume calculated in this SFS such that the capacity of the on-site cell is exceeded, the volume of excess RIM would be required to be transported and disposed at an off-site facility.

Section 5.3.4.1 would be rewritten as follows:

5.3.4.1 Siting of On-site Cell

As discussed in Section 2.3, the only available undeveloped portion of the West Lake Landfill property that is located outside of the geomorphic floodplain is the area that contains the Bridgeton Landfill, LLC on-site soil borrow area and soil stockpile. This area is located to the east of the former active landfill and south of the site stormwater management pond and the Bridgeton Landfill/hauling company yard area. This area is currently an open field containing natural in-situ soil and previously stockpiled soil for use in post-closure care of the inactive sanitary landfill and as potential cover soils for remedial actions for OU-2.

Use of this area would require the excavation and relocation of the stockpile soil prior to construction of a new on-site engineered disposal cell. Alternatively, implementation of the OU-1 remedy could be delayed until after completion of the OU-2 remedy so that a portion of the stockpiled soils could be removed prior to possible use of this area for construction of a new on-site cell. Other constraints associated with the on-site soil borrow and soil stockpile area include the fact that construction and operation of a disposal cell would be in close proximity to other property owners and businesses located along St. Charles Rock Road. This location is also the portion of the West Lake Landfill property located nearest to the Spanish Village residential area (approximately 3,200 ft) and a mobile home park (approximately 800 feet).

10 CSR 80-3.010(4)(B) lists the Site Selection Criteria that would need to be reviewed during design of an on site cell. These criteria include:

- **Airport safety;**
- **Floodplains;**
- **Wetlands;**
- **Seismic areas;**
- **Holocene faults; and**
- **Unstable areas.**

A preliminary screening-level review of these criteria suggests the following:

- **The on-site cell location would be approximately 8,000 feet from the end of Runway12W at the St. Louis Lambert International Airport. Discussions with the Federal Aviation Administration and the Airport owner the City of St. Louis would be necessary during the remedial design so that the cell construction and RIM relocation efforts could occur in a manner that would eliminate as much as possible bird hazards to aircraft. In addition, the existing Negative Easement and Restrictive Covenant prohibiting disposal of putrescible waste within the West Lake Landfill property would have to be waived by the City of St. Louis.**

- **As shown on Figure 5, the on-site cell area would be outside the limit the Missouri River geomorphic floodplain. Based upon a review of the most current published Federal Emergency Management Agency Flood Insurance Rate map number 29189C0039 H (August 2, 2005), this potential on-site cell location is also outside the limits of the 100-year floodplain.**

- **Review of the U.S. Fish and Wildlife Service's National Wetlands Inventory indicates that the potential on-site cell location area does not contain mapped wetland areas.**

- **In accordance with the MDNR SWMP regulation 10 CSR 80-2.015(1)(B), the geologic and hydrologic conditions of a proposed location for an on-site engineered disposal cell would need to be described in sufficient detail to allow a thorough evaluation. The end result would be compliance with the above regulations and, in the process, confirming the suitability of the site's geologic and hydrologic setting for the on-site engineered disposal cell. During this investigation, the study would review whether the site is located within a seismic impact zone, within 200 feet of a fault that has had displacement in Holocene time, and if any subsurface unstable areas exist beneath the proposed foundation location for the on-site cell. This investigation would be completed during the Remedial Design phase.**

Section 4.3.6 would be rewritten as follows:

4.3.6 New On-Site Disposal Cell

The "complete rad removal" with on-site disposal alternative would involve construction of an engineered cell of sufficient capacity to contain excavated RIM from Areas 1 and 2 along with daily cover, with a liner system that meets MDNR Solid Waste Management Program (SWMP) regulations and a cover system that meets MDNR SWMP requirements as well as UMTRCA requirements for radon

emission control. The on-site disposal cell would include leachate and gas collection systems; and the disposal cell area would include gas and groundwater monitoring systems. The longevity requirements of UMTRCA would also be used to determine the thickness of the cover for a new landfill cell such that the cover thickness limits gamma radiation and radon emissions to levels protective of human health and the environment and compliant with ARARs.

A cell would need to be sited on the West Lake Landfill property in an area not occupied by existing landfilled features as well as outside of the geomorphic flood plain. An area of sufficient size at the West Lake Landfill property that would be available for construction of a new engineered disposal cell would need to be identified. Post-closure maintenance and monitoring would also be required for the cell.

EPA FEEDBACK:

EPA accepts this response and the proposed text revision.

EPA Specific Comment No. 55

Comments

EPA Specific Comment No. 55 Appendix A-2, Section 2.2, first paragraph, page 4: The last sentence should explain why this assumption about the waste settlement was made.

Discussion

The surface elevations for the RI soil borings as reported for the RI (McLaren Hart, 1996), the surface elevations obtained from the 2005 topographic survey of the landfill, and the differences between these two values are summarized on Attachments A, B and C to Appendix A-2 of the draft SFS. As shown, in many cases there were differences between the 1995 surface elevation data for the RI soil borings and the more recent 2005 surface elevations of the landfill surface at each of the soil borings. For example, the surface elevation for RI soil boring WL-101 was reported (McLaren Hart, 1996) to be 456.5 ft above mean sea level (amsl). In contrast, review of the 2005 topographic survey map of the landfill indicated that the surface elevation at WL-101 was 455.53 ft amsl.

A number of possible reasons for such variations exist, including one or more of the following:

1. Differences in the accuracy and precision of the survey data (vertical benchmarks and horizontal control) used as the basis for the survey events and comparisons between the two surveys;
2. Localized variations in the surface elevations that result in significant variability in the 2005 topographic surface over small distances;
3. Consolidation and settlement of the landfilled wastes over the ten year period between the 1995 RI surveying activities and the 2005 topographic surveying effort;
4. Placement of additional fill material on the landfill surface during the intervening period between 1995 and 2005.

Appendix A-2, Section 2.2 of the draft SFS discussed the techniques used to quantify the RIM volume based upon the currently available data. As was explained in Section 2.2 of Appendix A-2, the 2005 elevations at each boring location were compared to the original ground surface elevations provided in the 1996 McLaren/Hart report for the RI soil borings. When the original boring elevations were compared to the 2005 surface topography, the lower of the two elevations were used for purposes of calculating the depth to the top and bottom of the RIM interval.

Use of the lower of the two elevations for purposes of calculating the depth to the top and bottom of the RIM is reasonable and conservative, and is based on an assumption that the primary cause of the differences between the two elevations was consolidation and settlement of the waste materials. The rationale for adopting this approach is that it assumes that settlement would primarily occur in the waste materials located below the RIM owing to the relatively shallow depths at which the RIM is located (compared to the overall depth of all of the wastes) and the resulting greater thickness of waste material (hence greater potential for settlement and consolidation) below the RIM compared to above the RIM. Accordingly, this approach preserves the original difference between the top of refuse and the top of the RIM identified on the soil boring logs. This is conservative in that it could result in a slight over-estimate of the volume of overburden waste that would need to be removed to provide access to the RIM compared to assuming that the thickness of RIM was compressed. Without site specific data regarding settlement, assumptions other than conservative ones would not be prudent.

SFS Text Revisions

The above text will be incorporated into Section 2.2 of Appendix A-2.

References

McLaren/Hart, 1996, Soil Boring/Surface Sample Investigation Report, West Lake Landfill Radiological Areas 1 and 2, Bridgeton, Missouri

EPA FEEDBACK:

EPA accepts this response and proposed text revision.

MDNR Section-Specific Comments Nos. 47, 48, 74, 76 and 91 – Long-Term Monitoring Duration and Cost Estimates

MDNR Section-Specific Comment No. 47

Comment

47.) Section 3.2.2 Off-site Transportation Requirements, page 31-32 - In addition to U.S. DOT regulations, Missouri Revised Statute section 260.392, RSMo (radioactive waste transport fees) will also apply.

Discussion

Section 3.2.2 of the text of the SFS will be amended to identify the Missouri regulations (Section 360.392 RSMo) relative to fees for transport of radioactive wastes. The regulation will be identified as a potential ARAR for off-site transport of RIM under the "Complete Rad Removal" with off-site disposal alternative. Assuming the waste materials meet the definition of "Low-level radioactive wastes" (260.392.1(4) RMSo), the fees for shipment would be $125 per truck or rail shipment. U.S. Ecology and Energy Solutions have indicated that the unit costs for transportation and off-site disposal of the RIM they provided include all transportation related fees.

Also, it should be noted that Sharon Cotner, USACOE Project Manager for the FUSRAP project in St. Louis (314-260-3915) indicated in a July 9, 2010 telephone conversation with an EMSI representative that she is not aware of any State of Missouri fees associated with transportation of radioactive wastes.

SFS Text Revisions

The following sentence will be added to Section 3.2.2 of the SFS:

> **State requirements and fees including Missouri fees for transport of radioactive waste (Section 260.392 RSMo) RIM would also potentially be applicable to the "Complete Rad Removal" with off-site disposal alternative.**

MDNR Section-Specific Comment No. 48

Comment

48.) Section 3.2.2 Off-site Transportation Requirements, page 31-32 - The document states "Discussions with representatives of potential off-site disposal facilities have indicated that most of the facilities would provide a turnkey service that includes transport of the RIM from the West

Lake site and disposal." Is this the best and most economical method of transporting and disposing of RIM to an off-site disposal facility. Since the cost of transport and disposal is the most significant cost variable, it is important to support this decision. Please provide an analysis of the various transportation and disposal methods and associated costs.

Discussion

Only three disposal facilities (U.S. Ecology's facility in Grandview, Idaho, the Energy*Solutions* facility in Clive, Utah, and Clean Harbors' Deer Trail facility in Last Chance, Colorado), have been identified that could accept RIM from the West Lake Landfill for off-site disposal. These companies provided unit costs for complete turnkey services for waste profiling and acceptance testing, waste transportation including all related fees and taxes, and waste disposal services including all related fees and taxes. Because these firms performed removal, transportation and off-site disposal services for SLAPS and DOE FUSRAP sites, use of these firms to provide estimates of the expected costs for transport and disposal of the RIM is consistent with a number of other EPA (EPA Additional Comment No. 32) and MDNR comments (MDNR General Comment No. 4 and Section-Specific Comment No. 97) relative to obtaining and relying on U.S. Army Corps of Engineers experience with other sites and the experience gained during removal of contaminated soil from SLAPS. Contacting trucking and rail companies to obtain independent estimates of the potential costs of transportation is considered outside the scope and level of detail required for preparation of FS-level costs estimates. Furthermore, it would be difficult to ascertain the degree of qualifications, capabilities and understanding such firms may have regarding the licensing, permitting, applicable fees, manifesting and placarding, health and safety monitoring, and other aspects of interstate transportation of radioactive wastes. The information provided by U.S. Ecology, Energy*Solutions*, and Clean Harbors is considered appropriate for an FS-level evaluation of potential alternatives.

In addition to the appropriateness of these cost evaluations for this phase, the companies evaluated in the FS have some experience performing the type of services that would be necessary for implementation of a "Complete Rad Removal" with off-site disposal alternative. In particular, U.S. Ecology Idaho has experience relative to excavation, transport and off-site disposal of radiologically-impacted soils from the following sites, including the St. Louis Airport Site (SLAPS):

Generator	Location	Waste	Classification	Tons
Molycorp (Chevron)	Washington, PA	Uranium and thorium contaminated waste	Source Material	169,000
Mallinckrodt	St. Louis, MO	Uranium and thorium contaminated soil and debris	Source Material	3,972
Kaiser	Tulsa, OK	Thorium contaminated waste	Source Material	90,000

Kiski Valley WPCA	Leechburg, PA	Incineration ash of sewage treatment sludge with low average concentration of enriched uranium	Special Nuclear Material	17,000
Department of Defense	Various military bases	Low-activity radium, uranium, depleted uranium, radioactive items, devices and parts	NORM and/or source material	70,000
USACE FUSRAP	Various	Uranium, radium and thorium soils and debris	Source Material, pre '78 11e2	2,000,000
Rare earth processing	Various	Uranium contaminated soils	Source Material and NORM	64,000
Oil/Gas pipeline	Various	Ra-226 and Pb-210 contaminated soils, debris & equipment	NORM	12,000

The Energy*Solutions* Clive, Utah facility has provided turnkey transportation and disposal services for large volumes of radiologically-impacted soils from the following sites:

Department of Energy – Fernald Closure Project – Ohio (Near Cincinnati)
Department of Energy – Rocky Flats Closure Project – Colorado (Near Boulder)
Department of Energy – Mound Closure Project – Ohio (Miamisburg)
Department of Energy – Columbus Closure Project – Ohio (Columbus)
U.S. Army Corps of Engineers – Maywood FUSRAP Site – New Jersey (Maywood)
U.S. Army Corps of Engineers – St. Louis FUSRAP Site – Missouri (St. Louis)
Commercial Entity – Kerr McGee – Chicago, Illinois
EPA – Ottawa – Illinois (near Chicago)
EPA – Denver Radium – Colorado

Finally, Clean Harbors maintains a fleet of more than 100 gondola cars that are dedicated to turnkey transportation of wastes to their various disposal facilities. A list of Clean Harbors' representative turnkey transportation and disposal projects is below. The majority of the projects involved the transfer of waste materials from the project site via trucks or intermodal containers to a truck-to-rail transloading facility located at a nearby leased rail spur. While not all of the Clean Harbors example projects listed below involved radiological wastes, they are representative of the industry-standard turnkey approach to transportation and disposal of large volumes of wastes.

Generator	Location	Waste	Tons
City of Denver, CO	OUs III and VII - Denver Radium CERCLA site	TENORM waste	25,000

USDOE	Former Nuclear Enrichment Facility	Lead contaminated soil	14,000
USDOE	Former Nuclear Enrichment Facility Decommissioning	Lubricating oils and Pyranol	150,000 gals oils 250,000 gals Pyranol
General Electric	Hudson River Sediment Remediation Phase 1	PCB-contaminated processed sediment (10, 81-car unit trains)	81,000
Government Agency	Government facility in St. Louis, IL	PCB contaminated soil (7 to 10 gondola cars per day Mon-Fri)	13,000 Phase 1 18,000 Phase 2
Shell Oil	Carson, CA Refinery Demolition	RCRA soil and debris	175,000
USDOE	Former Nuclear Enrichment Facility	PCB capacitors	750
Generator	Location	Waste	Tons
Somerset Tire and Sherwin Williams	Former Chemical Manufacturing site	Arsenic-contaminated soil	60,000
Sevenson Environmental	Federal Creosote CERCLA site	Creosote contaminated soil	25,000
Major Railroad	Lafayette, LA	Chlorinated solvent contaminated soil from train derailment (7 to 10 gondola cars per day Mon-Fri). Also, VOC contaminated water.	7,000 tons 100,000 gallons

Moreover, each of the identified turnkey transportation and disposal contractors would provide all coordination involved with leasing a nearby rail spur, waste profiling and acceptance testing, loading and manifesting each truck that leaves the site, and scheduling gondola car transportation with the respective railroads who own the track along the rail routes between the West Lake Landfill and the disposal facility location. In addition, transportation/disposal would be performed under a single agreement with the turnkey disposal facility contractor who would also indemnify the Respondents against all liability after the RIM would leave the site. Finally, if the "Complete Rad Removal" with off-site disposal alternative were selected, three turnkey contractors would be bidding for the transportation/disposal elements of the project which would provide sufficient competition to assure cost-competitiveness.

As noted above, because these firms performed removal, transportation and off-site disposal services for SLAPS and DOE FUSRAP sites, use of these firms to provide estimates of the expected costs for transport and disposal of the RIM is consistent with EPA and MDNR comments relative to obtaining and relying on U.S. Army Corps of Engineers experience with other sites and the experience gained during removal of contaminated soil from SLAPS. The information provided by U.S. Ecology, Energy*Solutions*, and Clean Harbors is considered appropriate for an FS-level evaluation in order to allow an economically appropriate choice to be made from the most qualified providers.

SFS Text Revisions

No revisions to the SFS text are proposed in response to this comment.

MDNR Section-Specific Comment No. 74

Comment

74.) Section 5.4.3.6 OM&M Components - On-site Disposal in Engineered Cell Alternative, page 71 - The requirement for monitoring for a period of 30 years may not meet the UMTRCA standards. Please consider longer periods of monitoring for the on-site disposal cell alternative.

Discussion

The reference to a 30-year period in Section 5.3.4.6 of the SFS relates to long-term monitoring of Areas 1 and 2 that would be performed after removal of the RIM under the "Complete Rad Removal" with on-site disposal alternative. Specifically, the sentence states "Groundwater and landfill gas monitoring of Areas 1 and 2 would also be required for a period of 30-years consistent with post-closure monitoring requirements for solid waste landfills (10 CSR 80-2.030(4)(A)3.E(1))."

Section 6.1.7.3 of the draft SFS identified and discussed the potential for long-term operation, maintenance and monitoring activities to extend beyond 30 years. Specifically, the draft text states "As wastes would remain on-site beyond 30 years and considering the longevity of radioactive materials, monitoring and maintenance activities would likely be required beyond the 30 year period used for preparation of the cost estimates."

The cost estimates for the ROD-Selected Remedy and the "Complete Rad Removal" with on-site disposal alternative will be revised to include costs for 1,000 years of OM&M activities in addition to costs for the 30 year period used for comparison of alternatives.

SFS Revisions

Section 5.3.1, which describes the various components of the ROD-Selected Remedy, will be amended to indicate that long-term OM&M of Areas 1 and 2 would be required beyond the 30-year post-closure period for solid waste landfills. Similarly, Section 5.3.4.6 , which describes the OM&M components of the "Complete Rad Removal" with on-site disposal alternative, will be amended to indicate that long-term OM&M of the new engineered on-site disposal cell would be required beyond the 30-year post-closure period for solid waste landfills.

MDNR Section-Specific Comment No. 76

Comment

76.) Section 6.1.7 Costs, page 80 - The document states "The cost estimates presented in the FS (EMSI, 2006) for remedial alternatives L4 and F4, which most closely parallel the ROD remedy, were reviewed, revised and updated to reflect additional requirements contained in the ROD, the results of preliminary engineering evaluations performed during preparation of the RD Work Plan (EMSI, 2009), and current published unit costs and cost factors." Please describe the "additional requirements contained in the ROD".

Discussion

The additional requirements contained in the ROD that were not in the FS, is the placement of rip-rap along the toe of the Area 2 portion of the landfill.

SFS Revisions

No revisions to the SFS are proposed in response to this comment.

MDNR Section-Specific Comment No. 91

Comment

91.) Section 6.2.1.7 Cost, page 99 - The Department recommends including a more representative cost of operations and maintenance of the remedy in perpetuity. This would better represent true cost. We understand the 30-year present worth cost may not significantly change. Also, does this cost include oversight costs?

Discussion

The estimates of the costs for the long-term OM&M activities beyond 30 years will be developed for both the ROD-Selected Remedy and the "Complete Rad Removal" with on-site disposal alternative. Cost estimates will be extended out to 1,000 years. As noted in the comment, such an extension will not significantly change the present worth cost estimates.

As noted in Section 6.1.7.1 of the SFS "Costs for regulatory oversight were not estimated in this SFS as it was assumed that they would be relatively similar among the alternatives and therefore would not contribute to the relative differences among the alternatives." In response to this comment, an estimate of potential oversight costs will be added to cost estimates for each of the alternatives. Specifically, oversight costs will be estimated at 5% of the capital costs exclusive of off-site transportation and disposal charges and before contingency costs.

SFS Text Revisions

The summary of the cost estimates contained in SFS Appendices I1, I2, and I3 will be extended to include 1,000 years of OM&M activities for both the ROD-Selected Remedy and the "Complete Rad Removal" with on-site disposal alternative. Costs for regulatory oversight of construction and OM&M will added at a rate of 5% of the capital costs (exclusive of off-site transportation and disposal costs and contingency costs) and 5% of the long-term OM&M costs.

EPA FEEDBACK:

EPA accepts these responses and proposed text revisions as provided.